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ABSTRACT

This document contains the materials required for presenting an 8-day competency-based technology learning activity (TLA) designed to introduce students in grades 6-10 to advances and career opportunities in the field of robotics-control technology. The guide uses hands-on exploratory experiences into which activities to help students develop basic skills have been incorporated. The document consists of an introductory section, instructor's guide, and student's guide. Presented in the introductory section are an overview of Oklahoma's technology education program and guidelines for using the instructor's and student's guides. The instructor's section contains the following: background information, expected learner outcomes, suggested learning activities, lesson plan, summary worksheet, pretest, posttest, test answers, evaluation summary, and bibliography. The student's guide contains one section for each of the TLA's 8 days. Each section includes some or all of the following: summary of activities and basic skills covered, goal, word list, expected learner outcomes, objectives, academic and workplace applications, information sheets, step-by-step learning activity outline, diagrams, handouts, and career search activity. An optional activity that could be used for solving problems or reinforcing learning is included. (MN)

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ED 380 601

Technology Learning Activity

Technology Education Series . .

ROBOTICS-CONTROL TECHNOLOGY

TLA TE-1112

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CIMC

Teacher Edition

Oklahoma Department of
Vocational and Technical Education
1500 West Seventh Avenue
Stillwater, OK 74074-4364

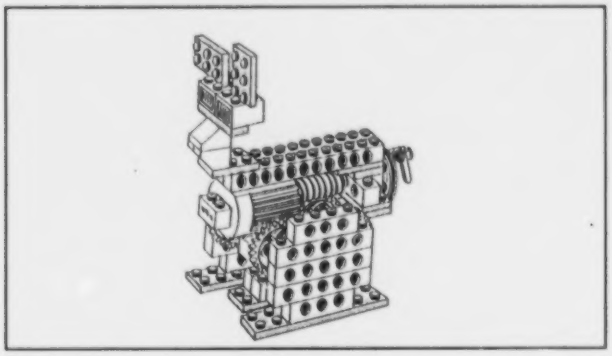
TECHNOLOGY EDUCATION

TECHNOLOGY LEARNING ACTIVITY

TE1112

ROBOTICS — CONTROL TECHNOLOGY

Suggested Time: 8 Days



Developed by the
Curriculum and Instructional Materials Center
for the Technology Education Division
Oklahoma Department of Vocational and Technical Education

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FOREWORD

What will be the careers of the future? The workforce of tomorrow will be shaped by the technologies being developed today. Students today need accurate, interesting information on growing technologies in order to make informed decisions about their futures.

It is our hope that this curriculum will help improve the quality of career decisions for our students. Students are introduced to a wide range of current, "cutting-edge" technologies and are encouraged to think critically about how those technologies influence their lives and futures. Today's students do not have to become the victims of "technological illiteracy," but instead can learn to anticipate technological developments and take positive steps to prepare for the future.

Technology Learning Activities provide students with the knowledge and an introduction to the skills they need for a positive learning and career experience. Every generation is faced with learning how to manage technological advances. Information gained through participation in the *Technology Education* program can help students develop a holistic view of technology on which to base their educational and career decisions.

Roy Peters, Jr., Ed.D., State Director
Oklahoma Department of
Vocational and Technical Education

Roger Stacy, Ed.D., Former State Supervisor
Technology Education
Oklahoma Department of
Vocational and Technical Education

PREFACE

We believe that one of the most effective ways to improve education is through the development and implementation of a sound instructional materials system. Technology Education instructional materials represent a new design for CIMC which recognizes the importance of graphic materials in the learning process.

Technology Education instructional materials are designed for 6th through 10th grade students. The design of these materials is based on current research on how people read and gain information from documents. The design is called "New Look" and integrates both graphics and text into a balanced presentation which is easy to use and follow.

Technology Education provides the student a look at what the world will be like in the future based on technologies in use and being developed today. Throughout the Technology Education instructional materials, the students are introduced to "cutting-edge" technologies that they will use and encounter in a working environment later in life. This exposure gives them a wide range of experiences on which to base career decisions.

This publication is intended as a starting point, from which the teacher can innovate, localize, and personalize in order to prepare students for their future. The *Technology Education* series of Technology Learning Activities was written with the realization that we are creating the workforce of tomorrow by how and what we teach about technology today.

Sherry Wietelman, Curriculum Development Specialist
Curriculum and Instructional Materials Center
Oklahoma Department of
Vocational and Technical Education

Charles F. Kemnitz, President
Atlati Communications, Inc.

ACKNOWLEDGEMENTS

The Curriculum and Instructional Materials Center (CIMC) extends its appreciation to those individuals who played important roles in the development of Technology Learning Activity materials.

Generous thanks is extended to Lynn Hawkins and Jim Harder, both Technology Education teachers at Mayfield Junior High School, for the time, talent and knowledge they contributed in determining the content of this Technology Learning Activity (TLA).

We also thank the State Director, Dr. Roy Peters, Jr., and the Assistant State Director, Dr. Charles O. Hopkins, for their continued support throughout this project.

The school administrator, Joe Shirley, who supported instructor participation in this project and allowed his facility to be used as a field test site deserves a special thank you, as well.

Oklahoma Department of Vocational and Technical Education Technology Education staff who provided leadership and direction on this project also deserve special recognition.

Roger Stacy, Ed.D.
Former State Supervisor
Technology Education

Donovan Bowers
Assistant State Supervisor
Technology Education

Harold Holley
Assistant State Supervisor
Technology Education

Appreciation and gratitude is expressed to Mr. John R. Brown, Technology Education Specialist, and LEGO DACTA®, LEGO Systems Inc., for their guidance and assistance in the development of this Control Technology Learning Activity. Thank you is also extended to Charles F. Kemnitz, Atlatl Communications, Inc.

Only through the close cooperation of the Curriculum and Instructional Materials Center staff was this curriculum developed. Sincere thanks are shared with the CIMC coordinators.

Brenda Stacy, Ed.D.
CIMC Coordinator

Lynna Ausburn, Ph.D.
CIMC Development Coordinator

Special recognition and thanks are also extended to other individuals within the Oklahoma Department of Vocational and Technical Education (ODVTE) involved in the development and distribution process: Noel Wilcoxson, Duane "Frosty" Foster and Diane Ensign and their staffs at the ODVTE Print Shop; Bob Davis and staff artist Kathryn Moore for the cover design; Darrel Stiles and his staff in the ODVTE Warehouse for packaging and coordinating transportation and distribution of these materials; and Rose Primeaux and her staff in Word Processing.

Finally, a big thank you to all ODVTE team members who offer their support on a daily basis in "behind-the-scenes" ways but never seem to be recognized for their contributions: Suzanne Perry and Terri Tomson, CIMC secretaries; Karen Heppel and Shirley Hill, Technology Education secretaries.

Sherry Wietelman
Curriculum Development Specialist
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and Technical Education

TECHNOLOGY EDUCATION OVERVIEW

About the Program

Because the American culture is distinctly characterized as technological, it becomes the function of our schools to give every student an insight into and an understanding of the technological nature of the culture. Technology Education strives to perform this function.

Technology Education in Oklahoma is an instructional program that provides young men and women (grades 6 - 10) with daily, hands-on exploratory experiences and insights into technology and career opportunities so that they can make meaningful occupational and educational choices. It is a program which can enhance the educational experience of all students, whether they are the valedictorian/honor-type student, the middle range/average student, or the student who has found little success in school, namely the at-risk student.

Technology Education acquaints all students with their technological environment so they can make rational decisions about their own lives on a day-to-day basis and participate in controlling their own destiny. The program directs students to related technological and industrial fields, enabling students to realize their full potential and make maximum use of their individual talents in fulfilling career goals in their selected areas of employment.

Technology education capitalizes on the individual's potential for reasoning and problem solving, for imagining and creating, and for constructing and expressing through the use of tools and materials related to technology. It develops content and

TECHNOLOGY EDUCATION OVERVIEW

experiences to contribute to the growth and development of students commensurate with their potential. Thus, Technology Education is a basic and fundamental study for all persons in regard to career explorations and educational opportunities.

Opportunities to develop and apply leadership, social, civic, and technologically related skills are provided through the Technology Student Association (TSA). TSA is the appropriate vocational student organization identified as a teaching tool for teachers to use in assisting students to achieve identified course competencies. Competency-based activities are an integral part of the instructional program.

All Technology Education courses are taught in a one-period block of time (45-55 minutes), with each of the four Technology systems (communication, construction, manufacturing, and transportation, energy and power) being designed to provide a means through which other courses such as math, science, English, and social studies can be applied in a practical manner within a technology-based situation. Teaching across the curriculum is vital to the success of a Technology Education program.

TECHNOLOGY EDUCATION OVERVIEW

About the TLAs

The *Technology Education* series consists of 40 Technology Learning Activities (TLAs) for instruction and a supplemental activities book. Each TLA is divided into two parts: an instructor's guide and a student guide. The instructor's guide provides an overview of Technology Education, a summary of activities and supplies needed for students to complete the Technology Learning Activity, a supplies and materials worksheet for the instructor, an overview of the particular TLA, written exam answer sheets, and evaluation summary for the TLA.

Master copies of the evaluation summary sheets, pretest and posttest, and supplies and materials worksheets are provided with this instructors edition of the TLA. These sheets may be reproduced for classroom use.

All of the TLAs focus on measurable and observable learning outcomes. Instructors are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

TLAs are designed for use in more than one class period of instruction. Careful study of each TLA by the instructor will help her or him determine the following:

- Skills to demonstrate
- Supplies and equipment needed

TECHNOLOGY EDUCATION OVERVIEW

- Amount of time needed for student practice
- Workstation Bookshelf, Instructors Reference Materials, and a bibliography are provided for supplemental resources
- Supplementary materials, including print and non-print media to order
- Resource people to contact
- Facility modifications which may be necessary to administer the TLA

Each TLA is based on performance objectives. Performance objectives are specific, stating the performances necessary to meet the goal of the TLA.

The overall goal of the unit tells what the student should be able to do and what standard will be used to determine whether the student has achieved competency. The specific objectives outline the sequence of the competencies required to meet the TLA goal. The competencies may be either cognitive, requiring knowledge only, or psychomotor, requiring knowledge and skill.

TECHNOLOGY EDUCATION OVERVIEW

About Ordering TLAs

Additional TLAs in the *Technology Education* series may be ordered through the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, OK 74074-4364. Phone 1-800-522-5810.

NOTE: The 1100- and 1200-series numbers given on the next page are for ordering TLA Instructor's Editions; to order Student Editions, change the first two numbers to 31 (for 8-Day TLAs) or 32 (for 6-Week TLAs).

TECHNOLOGY EDUCATION OVERVIEW

TLA Title	Order No.
8-DAY TLAs	
Aerospace and Flight	TE1117
Agricultural Education	TE1123
Audiovisual Programming	TE1131
CAD — Autocad Release 10	TE1114
Career Search	TE1104
Drafting	TE1134
Electricity — Principles and Applications	TE1105
Electronic Publishing	TE1135
Electronics (CES)	TE1106
Fluidics Technology	TE1116
Health Occupations	TE1124
Home Economics	TE1125
Introduction to VoTech	TE1122
Introduction to Animation	TE1132
Keyboarding and Computer Application	TE1115
Laser/Fiber Optics/Holography	TE1129
Lasers Technology	TE1103
Marketing Education	TE1126
Material Processes — Plastics	TE1133
NASA Aerospace-Spacelink	TE1111
Photography	TE1130
Problem Solving	TE1110
Research and Design	TE1101
Residential Construction	TE1121
Robotics — Control Technology	TE1112
Robotics — ProArm	TE1113
Safety (Design Briefs)	TE1107
Structural Engineering	TE1102
Synergetic Technology	TE1120
Technical Report Writing	TE1118
Technology Challenge	TE1109
Thermal Screen Printing	TE1119
Trade and Industrial Education	TE1127
TSA Leadership	TE1108
Vocational Business	TE1128
6-WEEK TLAs	
Animator	TE1203
CAD/Board Drafting	TE1201
Control Technology	TE1202
Electronics/Electricity/Robotics	TE1204
Electronic Publisher	TE1205

TECHNOLOGY EDUCATION OVERVIEW

Corrections and Suggestions

CIMC wants to provide Technology Education instructors and students materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications or have suggestions for improving their usefulness, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and indicate the correction on the copy. Mail this information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Curriculum Development Coordinator
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

USING THIS PUBLICATION

INSTRUCTOR'S SECTION

Background Information

The background information component provides instructors with basic information about the subject of the TLA. Instructors are encouraged to use suggested resources for additional information on the specific technology used in each TLA.

Expected Learner Outcomes

There are 19 Expected Learner Outcomes for the *Technology Education* series. Not every TLA fulfills all 19 Expected Learner Outcomes, so outcomes specific to each TLA are listed in the Instructors Section and in the Students Section. The 19 Expected Learner Outcomes for the *Technology Education* series are:

- The student will know and appreciate the importance of technology and technological literacy.
- The student will explore career opportunities so they can make meaningful occupational choices.
- The student will explore future educational opportunities so they can make meaningful educational choices.
- The student will apply problem solving and critical thinking techniques.
- The student will apply math, science, reading, and other school subjects in a practical situation.
- The student will develop keyboarding and computer literacy skills.

USING THIS PUBLICATION

INSTRUCTOR'S SECTION

- The student will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- The student will recognize and develop individual talents.
- The student will think logically and sequentially.
- The student will develop leadership, creative abilities, positive self-concepts, and individual potential in a technological society.
- The student will become a more sophisticated consumer of the goods and services of a technological society.
- The student will adjust to a changing technological environment.
- The student will develop an understanding and the ability to adapt to those technological forces that influence life in the 21st century.
- The student will develop an understanding of economic development.
- The student will communicate by making clear and relevant points through the development of mental process skills.

USING THIS PUBLICATION

INSTRUCTOR'S SECTION

- The student will apply design, imagination, and creative abilities.
- The student will learn applications of lifelong learning skills.
- The student will think globally and act locally.
- The student will explore the organization and management systems of business and industry.

Suggested Activities

The suggested activities component is to assist during the preparation stage of the teaching/learning process. The activities provide suggestions for preparation and evaluation during the instructional process. The instructor should read the suggested activities before assigning the TLAs to allow time to obtain supplemental materials, prepare audiovisual materials, and contact outside resource persons. Duties of the instructor will vary according to the particular TLA.

USING THIS PUBLICATION	INSTRUCTOR'S SECTION
Suggested Resources	Suggested resources, include people, and print and non-print media that may be used with the TLA. References used during the development of each TLA are also provided. The instructor can use suggested resources and TLA references to supplement her or his knowledge of the subject to help students with particular interests or objectives in the area covered. Please note that suggested resources and references listed in this publication existed when this publication was written. CIMC assumes no responsibility for providing these materials and cannot ensure the availability of these materials as individual vendors, manufacturers, and publishers may discontinue these products at any time.
Instructional Sequence	This component provides instructors with daily lesson plans for the TLA. Included in the instructional sequence component are suggested daily assignments and equipment, tools, and supplies that will be needed for each student. A column for facility requirements or modifications is provided for each instructor. This component is provided as a guide to plan for and monitor students' progress through the TLA.
Equipment, Tools, and Supplies: Summary Worksheet	This component is provided as a planning tool for instructors. It provides instructors with a list of the necessary equipment, tools and supplies to support student activities and provides specific information for budgeting purposes.

USING THIS PUBLICATION	INSTRUCTOR'S SECTION
Pretest and Posttest	These components provide criterion-referenced evaluation of the objectives listed in each TLA. If objectives or activities have been added, deleted, or modified, appropriate changes should be made on the tests.
Test Answers	This component is provided to assist instructors in evaluating student performance on written tests.
Evaluation Summary	This component is provided to assist instructors in summarizing the performance of each student on an individual basis. The evaluation summary forms are also provided as photocopy masters for the instructors use.

USING THIS PUBLICATION

STUDENT'S SECTION

Introduction

Daily activities are the step-by-step procedures students will follow to complete the learning experience. Each TLA is organized by daily tasks and activities. Students are able to pace their progress through the TLA by referring to the activities for the day.

Within the daily activity pages are components common to all TLAs.

Summary of Activities

A Summary of Activities page begins each day of the TLA. This page provides several important pieces of information for both the student and instructor.

❶ In the left column this page provides the student with a list of activities to be accomplished that day.

❷ In the right column the major Academic and Workplace Application which applies to that day's activities is graphically indicated with a standard icon.

❸ Below the icon is a list of specific skills reinforced during that day's activities.

USING THIS PUBLICATION	STUDENT'S SECTION
Pretest Instructions	The students are required to take a Pretest as one of the first day's activities. The instructions for the Pretest are given in this section.
Assignments to Turn In	Day One includes a list of all assignments the students are expected to turn in during or at completion of the TLA. This list includes all tests, activities, and products covered in the TLA.
Goal	On Day One, following the assignments checklist, is a concise statement of the overall goal of the TLA. This statement summarizes the purpose for completing the TLA and encourages the student to think about the broader implications of the learning experience.
Words You Should Know	The first day's activities includes a glossary of unfamiliar technical terms used in the TLA. Often these terms are necessary for the student in order to accurately follow instructions in the activity procedures. The students should be encouraged to review this glossary and refer to it often during the course of the TLA.

USING THIS PUBLICATION	STUDENT'S SECTION
Expected Learner Outcomes Reinforced by this TLA	As stated in the guide to the Instructors Section, there are 19 identified Expected Learner Outcomes associated with the *Technology Education* series. This section of Day One activities lists the Expected Learner Outcomes that specifically apply to the TLA. A student who reviews this list will gain a better understanding of the scope of experiences and skills to be gained from the TLA.
Objectives	Each TLA is made up of a set of measurable objectives. In this section on Day One, students are given a list of all the objectives addressed in the TLA. This list can serve to introduce students to the "flow" of the TLA as they build introductory skills in a technology.
Related TSA Competitive Event(s)	Each TLA may be used by students to begin work toward completion of a Technology Student Association competitive event. Some TLAs are tied to a specific TSA event; other TLAs may be used with several events. This Day One section gives the student and instructor a list of appropriate TSA events which the TLA may support. TSA competitive events promote leadership development, and an understanding that winning isn't everything but involvement is. Events are staged at Local, Regional, State, and National levels through which the student may progress.

USING THIS PUBLICATION

STUDENT'S SECTION

Academic and Workplace Applications

The curricular content and activities found in this Technology Learning Activity help students apply academic and workplace competencies. These competencies include: Reading Skills, Writing Skills, Mathematics Skills, Science Skills, Oral Communications Skills, Interpersonal or Relating Skills, Creative Thinking and Problem Solving Skills, Employability Skills, and Social Studies Skills.

Preparing students to enter successfully into today's world ...

Preparing students to enter successfully into today's world of work offers vocational education a substantial challenge. The contemporary workplace is characterized by constant and rapid technological change and by increasing job complexity and skill intensity. Due to rapid technological advancement, the half-life of work skills is now reduced to a bare three to five years. Out of this new workplace environment has arisen a growing national awareness of the critical importance of an American workforce armed with the skills necessary to survive in a competitive economy.

... emergence of a renewed emphasis on basic academic skills ...

One result of this national awareness has been the emergence of a renewed emphasis on basic academic skills in all areas of education. Pressure to increase academic skill development is being placed on education by both legislative action and industry mandate. The Carl D. Perkins Vocational and Applied Technology Education Act of 1990 sets stringent academic and workplace skill requirements for vocational education. State legislatures are increasingly requiring basic skills accountability by teachers and school administrators.

USING THIS PUBLICATION	STUDENT'S SECTION
... expected learner outcomes are being implemented with increasing frequency.	Graduation exams, minimum competency requirements, and expected learner outcomes are being implemented with increasing frequency. In addition, business and industry are delivering the message clearly to educators that vocational competence now requires increased strength in academic and workplace skills.
The issue of basic skills ... was successfully addressed in a national three-year study ...	The issue of the basic skills currently required in the work place was very successfully addressed in a national three-year study conducted jointly by the American Society of Training and Development (ASTD) and the U.S. Department of Labor (DOL). The findings of this study were published in 1990 in the book, *Workplace Basics: The Essential Skills Employers Want.*
... research indicates clearly that American employers ... need a variety of skills ...	The ASTD/DOL research indicates clearly that American employers have discovered that their workforces need a variety of skills that include, but are not limited to, the classic academic trio of reading, writing, and computation. Employers now are also looking for competence in areas such as "learning to learn," problem solving and critical thinking, interpersonal and teamwork skills, oral communication and listening techniques, and the social and personal management skills that demonstrate a capacity for independence and responsibility in on-the-job performance.

USING THIS PUBLICATION

STUDENT'S SECTION

... business and industry have expanded and re-defined "workplace basics."

It is clear that the requirements of today's business and industry have expanded and re-defined "workplace basics." It is in line with this re-definition, and with the competency requirements of current education legislation, that the Oklahoma Department of Vocational and Technical Education has chosen to address "basic skills" in the instructional materials produced by its Curriculum and Instructional Materials Center.

CIMC materials contain information and activities which develop academic and workplace application competencies ...

It is not a new development for CIMC materials to contain information and activities which develop academic and workplace application competencies in students undertaking vocational programs. What is new is the specific marking, or flagging, of items in our instructional materials that address academic and workplace application skills.

To assist teachers and students in identifying activities which promote academic and workplace skills ...

To assist teachers and students in identifying activities which promote academic and workplace skills development, CIMC has implemented a marking system which uses simple graphic symbols, or icons. These icons are located in the right margins of Activity Sheets. The following is an explanation of the icons and the kinds of academic and workplace application activities they indicate.

USING THIS PUBLICATION

READING SKILLS: Skills involving use of print resource material for obtaining and applying information.

WRITING SKILLS: Skills involving written communication of processes, information, or ideas.

MATHEMATICS SKILLS: Skills involving computation, calculation, and interpretation of numerical data.

STUDENT'S SECTION

Current vocational education literature indicates that functional literacy as a workplace basic needs to be defined in terms of reading competencies actually required for job performance. The activities identified with this icon as addressing reading skills in CIMC materials deal specifically with developing reading skills in an applied, job-related context. These range from general information-gathering activities to tasks requiring use of specific technical reference materials. Many contain a "learning to learn" aspect, which promotes engaging actively and purposefully in vocationally relevant enquiry.

Tasks identified with this icon promote development of skills in written communications. As with reading skills, the writing skills emphasized in CIMC materials have a vocational context. They include filling out forms, keeping work activity records, writing simple memos and letters, generating more complex reports and articles, and written expression of ideas and concepts related to vocational performance or exploration.

This icon identifies activities which develop vocationally-related skills in computation, measurement and estimation, selection and application of appropriate mathematical processes, and collecting, displaying, or interpreting data.

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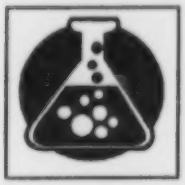

SCIENCE SKILLS: Skills involving mastery and application of scientific information or theory.

ORAL COMMUNICATION SKILLS: Skills involving speaking and listening.

INTERPERSONAL OR RELATING SKILLS: Skills involving working and getting along with others.

STUDENT'S SECTION

This icon marks activities which are related to the development of skills in either the physical or biological sciences. These skills stress occupationally-related applications of science and technology.

Activities marked with this icon promote development of effective speaking and listening. They include practice in such areas as speaking techniques, word choice, non-verbal messages, use of communication media, and using active listening techniques. Many of these activities promote "learning to learn" skills in verbal enquiry.

Activities which deal directly with skills in relating to others are marked with this icon. This includes areas such as multi-cultural awareness, group processes and dynamics, negotiation, dealing with conflict, cooperation and teamwork, values and attitudes, and leadership and motivation.

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CREATIVE THINKING AND PROBLEM SOLVING SKILLS: Skills involving comprehending, applying, analyzing, and developing complex ideas and situations.

EMPLOY-ABILITY SKILLS: Skills involving choosing, obtaining, and succeeding in a career.

SOCIAL STUDIES SKILLS: Skills involving investi-gation and application of social concepts.

STUDENT'S SECTION

This icon identifies activities which stress development of higher-order thought processes such as problem identification and analysis, lateral thinking, evaluating alternatives, developing solutions, examining assumptions, and evaluating outcomes.

Activities marked with this icon relate to competencies required to obtain employment and develop a career. These competencies include specific occupational tasks. They also include items such as career analysis and selection, job searching, completing applications and resumes, interviewing, and business etiquette and personal management skills required for job-keeping and maturing in one's work. Examples of the latter category include personal presentation, self-discipline, work accuracy, reliability, discretion, punctuality, stress handling, judgement, confidence, etc.

This icon marks activities which stress competencies in fields relating to human society and its distribution and relationships. This includes areas such as history, geography, government and politics, economics, psychology, sociology, demographics, current events, cross-cultural studies, consumer issues, environmental issues, and ethical concerns in science and technology.

USING THIS PUBLICATION

Impact Statements

STUDENT'S SECTION

There are five areas of human culture for which each TLA has an impact. These impact statements appear during Day Eight, after the student has gained some familiarity with the technology.

1. *ENVIRONMENTAL IMPACT:* A statement introducing the student to the impact of the technology on the environment.

2. *SOCIAL/CULTURAL IMPACT:* A statement concerning the impact of the technology on society and culture.

3. *ECONOMIC IMPACT:* A statement concerning the impact of the technology on the economy.

4. *POLITICAL IMPACT:* A statement concerning the impact of the technology on politics, laws, and regulations, and the impact of politics on the development of the technology.

5. *ERGONOMIC IMPACT:* A statement concerning the ergonomic implications of the technology. Ergonomics is the study of developing products and systems that meet peoples' needs.

USING THIS PUBLICATION	STUDENT'S SECTION
	Impact Statements offer the student the opportunity to see beyond the activities in the Technology Learning Lab and glimpse the real-world applications of the technology.
Career Search	Also on Day Eight, the students are given the assignment of investigating several career opportunities related to the technology of the TLA. The investigation is done with *Career Search Abstracts*. A list of up to five careers related to the TLA is given, followed by pages from *Career Search Abstracts* that detail the career qualifications and work environment. The student is required to choose two of the five related careers, read the appropriate abstracts, then write a short essay about why those careers may be appealing.
Posttest Instructions	The students are required to take a Posttest as one of the last day's activities. The instructions for the Posttest are given in this section. The score for the Posttest may be compared to the score for the Pretest to help determine the student's gain during the TLA.

USING THIS PUBLICATION

Skunk Works

STUDENT'S SECTION

Skunk Works, a Day Eight optional activity, include instructions that could be used for solving problems or reinforcing the enrichment of learning.

The term Skunk Works was coined by engineers at 3M Corporation in the mid-1960s. Some engineers wanted to develop a new product, but company management would not give them the time or money to work on the project. So the engineers "borrowed" time and money from approved projects to work on their "Skunk Works." When they finished developing the product, they presented it to management and it has been a 3M product ever since. The product: Velcro fasteners.

HAZARD ALERT MESSAGES

The Daily Activities include hazard alert information specific to the Activity. These messages should be discussed carefully and thoroughly. The Hazard Alert Message system used in the TLA is based on the American National Standards Institute (ANSI) Standard Z535, which provides for five levels of alert.

Students are introduced to the ANSI Hazard Alert Message system as an activity in the Safety (Design Briefs) (TE1107). This system was adopted by ANSI as the standard in 1990 and will be the hazard alert system in use when students reach the workplace.

Hazard Alert Messages in the TLA are indicated both by the color red and graphically. There are three types of hazard alert graphics used in the TLA: the hazard alert symbol, injury hazard graphics, and avoidance graphics.

Hazard Alert Symbol

This Hazard Alert Symbol is used with the words DANGER, WARNING, and CAUTION. ANSI defines these words as:

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

HAZARD ALERT MESSAGES

Injury Hazard Graphic

There are two types of graphics used in conjunction with the hazard alert symbol. This type of graphic depicts a specific injury that may be expected if the hazard described in the alert is not avoided.

Avoidance Graphic

This second type of graphic is called an avoidance graphic. It depicts an action the student should take in order to avoid injury.

There are two other ANSI words used in the TLAs and the students should understand their meanings:

NOTICE indicates an action that could result in damage to property or equipment.

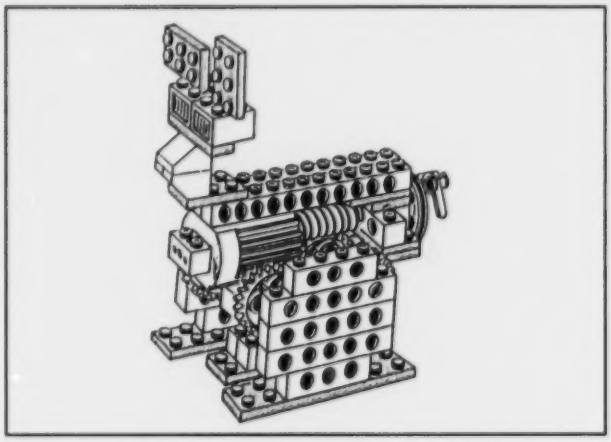
IMPORTANT indicates an instruction that can help the student do a better job.

TECHNOLOGY EDUCATION

ROBOTICS — CONTROL TECHNOLOGY

TE1112/TE3112

INSTRUCTOR'S SECTION



BACKGROUND INFORMATION

Every time a car moves, a bicycle wheel turns, or you go up a ramp, machines are making our lives easier. Machines affect almost everything we do, even though we do not always notice them around us.

Only 6 different simple machines exist. They are the lever, wheel and axle, pulley, inclined plane, wedge, and screw. These can be put together in combinations to make all other machines, even a car or an airplane.

Each of these simple machines makes work easier by doing more with less energy. Riding a bicycle to school is easier and faster than walking because of the mechanical advantage of the machines. (A bicycle uses two machines to create mechanical advantage: wheels and axles, and a pulley.)

Engineers can calculate the mechanical advantage of machines by using different formulas. The mechanical advantage is similar to the power of a machine, which is the amount of work done in a certain amount of time. We calculate the work as the force times the distance.

— continued —

INSTRUCTOR'S SECTION

EXAMPLE:
When you walk to school, you do a certain amount of work—you move yourself (force) to school (distance). If you ride a bicycle the amount of work is the same (force x distance) but the power is different.

Let's say it takes 20 minutes to walk but only 5 to ride. That means it took 4 times longer to do the work (going to school) without the mechanical advantage of the bicycle.

Using a bicycle you can use four times as much power as when you walk, without using any more energy. You notice this later, because you are just as tired if you ride as if you walk.

BACKGROUND INFORMATION

The energy needed to do work comes from many different sources. Sunlight, running water, wind, burning gasoline and the food you eat are all sources of energy.

The wind, running water and things which move have mechanical energy. Sunlight, burning gasoline and your food do not have mechanical energy because they do not move, but we can change the energy into mechanical energy.

If the sunlight makes an electric car move, if the gasoline is burned in an engine, if you pedal your bicycle, the energy becomes mechanical energy.

If we can use mechanical energy to do work, it is called mechanical power (or just power). The devices for using mechanical power are machines.

Machines can be very useful, if they are controlled, but if they aren't controlled they can be dangerous. Just think of a moving car without a driver or a bicycle you cannot steer or stop.

Machines can be controlled by people (like a bicycle), by the machine itself (like a fan which can only go at one speed and not faster), or by computers (like airplanes or manufacturing tools).

— continued —

INSTRUCTOR'S SECTION

Control Technology—using machines or computers to control other machines—is a complicated name for a simple idea. Control Technology really only turns devices on and off at the right times.

BACKGROUND INFORMATION

Just as you understand the difference between true and false, the computer understands the difference between on and off. However, until someone programs it, the computer doesn't understand anything but on and off. It doesn't understand 1, 2 and 3; it doesn't understand red, white and blue.

Computer programmers have taught the computer how to "think" almost as we do, by making Logo and other computer programming languages. As you use Logo you will see just how much the computer really can understand.

In the Control Technology TLA you will be building machines which do work. Additionally, you will use a computer to control the machines, to allow you to change what the machines do as easily as typing a new command into a computer.

INSTRUCTOR'S SECTION

Because of these languages, we can talk to a computer in almost normal language. We can tell it to turn a light on, or turn it off. We can even tell it to wait for something to happen, and then turn the light off. Even the most complicated computer games are just fancy ways of turning switches on and off.

EXPECTED LEARNER OUTCOMES

- The student will know and appreciate the importance of technology and technological literacy.
- The student will explore career opportunities so they can make meaningful career choices.
- The student will explore future educational opportunities so they can make meaningful educational choices.
- The student will apply problem-solving and critical thinking techniques.
- The student will apply math, science, reading, and other school subjects in a practical situation.
- The student will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- The student will recognize and develop individual talents.
- The student will think logically and sequentially.

— continued —

INSTRUCTOR'S SECTION

EXPECTED LEARNER OUTCOMES

- The student will develop leadership, creative abilities, positive self-concepts, and individual potential in a technological society.
- The student will become a more sophisticated consumer of the goods and services of a technological society.
- The student will adjust to a changing technological environment.
- The student will develop an understanding and the ability to adapt to those technological forces that influence life in the 21st century.
- The student will communicate by making clear and relevant points through the development of mental process skills.
- The student will apply design, imagination and creative abilities.
- The student will learn applications of lifelong learning skills.
- The student will think globally and act locally.

INSTRUCTOR'S SECTION

SUGGESTED ACTIVITIES

✓ Obtain materials to supplement TLA.

See Suggested Resources for computer software and books to supplement this module.

✓ Review instructional outline for this TLA. Modify time frames to suit class needs and plan activities for each class period.

✓ Install the LEGO DACTA Computer Interface Card, the Interface Box, and the software on a computer work station.

✓ Prepare instructions for students on booting the computer and preparing to work each day.

✓ Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

✓ Determine scope and sequence of objectives that you add to the TLA. Design and develop support materials, including evaluation techniques, for additional objectives.

— continued —

INSTRUCTOR'S SECTION

PREPARATION

SUGGESTED ACTIVITIES

- ✓ Determine how you will schedule time for students to demonstrate competence in the required procedures.
- ✓ Make arrangements for guest speakers. Supply speakers with specific objectives and other appropriate sections of this TLA.

INSTRUCTOR'S SECTION

SUGGESTED ACTIVITIES

Todd, Ronald D., David L. McCrory, and Karen L. Todd. *Understanding and Using Technology*. Davis Publications, Inc. Worcester, Massachusetts, 1985. Chapter 14, pp. 295-314.

INSTRUCTOR'S SECTION

WORKSTATION BOOKSHELF

INSTRUCTOR'S REFERENCE MATERIALS

LEGO TC Logo Reference Guide. LEGO Group. LEGO DACTA Educational Products. Enfield, Connecticut, 1989.

Technic Control I Resource Guide. LEGO Group. LEGO DACTA Educational Products. Enfield, Connecticut, 1991.

Todd, Ronald D., David L. McCrory, and Karen L. Todd. *Understanding and Using Technology*. Davis Publications, Inc. Worcester, Massachusetts, 1985. Chapter 14, pp. 295-314.

Instructional Sequence	Technology Education: Robotics — Control Technology		
	Assignments	**Equipment, Tools, and Supplies**	**Facilities Requirements/ Modifications**
Day 1	Take Pretest Read Assignments to Turn In, Goal, Words You Should Know, Expected Learner Outcomes, Objectives, Related TSA Competitive Events, Academic and Workplace Applications	Computer score sheet/card for Pretest #2 pencil	
Day 2	Read Information Sheet Complete Objective 1: Build a light system and program it to control traffic lights, including turning on, turning off, waiting, and repeating	LEGO DACTA Technic Control I Set Computer with LEGO Interface Box LEGO TC Logo	
Day 3	Complete Objective 2: Build a car and program it to move, stop, reverse direction, and speed up and slow down	LEGO DACTA Technic Control I Set Computer with LEGO Interface Box LEGO TC Logo	
Day 4	Complete Objective 3: Build a car and warning lights and program the two systems together	LEGO DACTA Technic Control I Set Computer with LEGO Interface Box LEGO TC Logo	
Day 5	Complete Objective 4: Build a "Sensational Wash" and program it, including using an optosensor to control the system	LEGO DACTA Technic Control I Set Computer with LEGO Interface Box LEGO TC Logo	
Day 6	Complete Objective 5: Build a trundle wheel and program it, including using a tone to tell when the system ends the program	LEGO DACTA Technic Control I Set Computer with LEGO Interface Box LEGO TC Logo Enlarged map from Instructor's Section	
Day 7	Complete Objective 6: Build a "Dogbot" and program it, including moving the Dogbot and playing music	LEGO DACTA Technic Control I Set Computer with LEGO Interface Box LEGO TC Logo	
Day 8	Read Impact Statements Complete Career Search Activity, any unfinished assignments, Posttest, Skunk Works (if time)	Computer score card/sheet #2 pencil 2 sheets notebook paper LEGO DACTA Technic Control I Set Computer with LEGO Interface Box LEGO TC Logo	

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Equipment, Tools, and Supplies:
Summary Worksheet

Equipment, Tools, and Supplies	Per Student	Per Period	Total Needed	Special Considerations	Cost per Student	Cost per Period	Total Cost	Special Considerations
#2 pencil	1	24	24					
Computer score card/sheet	1	24	26	Mistakes (2)				
Notebook paper	2	48	54	Mistakes (6)				
LEGO DACTA Technic Control Set I	1	1	1					
Computer with LEGO Interface Box	1	1	1					
LEGO TC Logo	1	1	1					
Enlarged map from Instructor's Section	1	1	1					

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PRETEST

INSTRUCTOR'S SECTION

PART 1

1. An interface box changes information so computers can use it.

   a. true
   b. false

2. Computer programming can only be done by people in big companies.

   a. true
   b. false

3. Computer control technology is just used in factories.

   a. true
   b. false

4. A _____ is not a simple (on/off) system.

   a. refrigerator
   b. light bulb
   c. lawnmower engine
   d. none of the above.

5. Subprocedures are used to

   a. save the computer memory
   b. provide greater speed when running the program
   c. make it easier to debug the program
   d. allow more people to use the program

— continued —

PRETEST

INSTRUCTOR'S SECTION

PART 2

6. Remote control televisions have optosensors to see the commands from their remote control units.

   a. true
   b. false

7. Computer control technology systems only use sound to provide feedback to the other subsystems.

   a. true
   b. false

8. Because of computer control technology systems more jobs than ever before are very dangerous for the workers.

   a. true
   b. false

9. Ergonomic uses of Control Technology systems include:

   a. electric eyes to open doors.
   b. automatic supermarket systems.
   c. nuclear plant clean-up devices
   d. none of the above

10. An interface port is used to

    a. collect information
    b. send out information
    c. either a or b.
    d. not a or b.

POSTTEST

11. An interface box changes information so computers can use it.

    a. true
    b. false

12. Computer programming can only be done by people in big companies.

    a. true
    b. false

13. Computer control technology is just used in factories.

    a. true
    b. false

14. A _____ is not a simple (on/off) system.

    a. refrigerator
    b. light bulb
    c. lawnmower engine
    d. none of the above.

15. Subprocedures are used to
    a. save the computer memory
    b. provide greater speed when running the program
    c. make it easier to debug the program
    d. allow more people to use the program

— continued —

INSTRUCTOR'S SECTION

PART 1

POSTTEST

16. Remote control televisions have optosensors to see the commands from their remote control units.

    a. true
    b. false

17. Computer control technology systems only use sound to provide feedback to the other subsystems.

    a. true
    b. false

18. Because of computer control technology systems more jobs than ever before are very dangerous for the workers.

    a. true
    b. false

19. Ergonomic uses of Control Technology systems include:

    a. electric eyes to open doors.
    b. automatic supermarket systems.
    c. nuclear plant clean-up devices
    d. all of the above

20. An interface port is used to

    a. collect information
    b. send out information
    c. either a or b.
    d. not a or b.

INSTRUCTOR'S SECTION

PART 2

POSTTEST

21. Axel
22. Debugging
23. Interface
24. Proceedure
25. Senser
26. Primitive
27. Mechanical
28. program
29. comand
30. optisensor

INSTRUCTOR'S SECTION

SPELLING TEST

TEST ANSWERS

1. a
2. b
3. b
4. d
5. c

6. a
7. b
8. b
9. d
10. c

INSTRUCTOR'S SECTION

PRETEST ANSWERS

TEST ANSWERS

11. a
12. b
13. b
14. d
15. c

16. a
17. b
18. b
19. d
20. c

21. b
22. a
23. a
24. b
25. b

26. a
27. a
28. a
29. b
30. b

INSTRUCTOR'S SECTION

POSTTEST ANSWERS

SPELLING TEST ANSWERS

EVALUATION SUMMARY

10 POINTS EACH:

Pretest _____

Career Search _____

80 POINTS:

Objective 2: Build a car. _____

Objective 3: Build a car and warning lights. _____

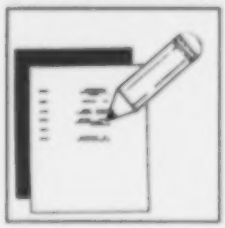
Objective 4: Build a "Sensational Wash." _____

Objective 5: Build a trundle wheel. _____

Objective 6: Build a "Dogbot." _____

INSTRUCTOR'S SECTION

1. PROCESS EVALUATION



1. PROCESS EVALUATION SCORE _____

EVALUATION SUMMARY

The instructor is encouraged to individualize the TLA to address the specific needs of each student, considering age and ability level. In addition to the specific areas on the chart below, the instructor should take into account the student's desire, enthusiasm, etc.

Evaluation based upon observed performance = 40 possible points.

EVALUATION RATING TABLE

Student Name: _____

Criteria	Points Possible	Points Earned
Programming light system	5	_____
Programming car	5	_____
Programming two systems	7	_____
Programming "Sensational Wash"	7	_____
Programming trundle wheel	8	_____
Programming "Dogbot"	8	_____

— Continued —

INSTRUCTOR'S SECTION

2. PRODUCT EVALUATION

EVALUATION SUMMARY

Use the conversion table below to convert Product Evaluation scores to percentiles.

40 = 100%
39 = 97.5
38 = 95
37 = 92.5
36 = 90

35 = 87.5
34 = 85
33 = 82.5
32 = 80

31 = 77.5
30 = 75
29 = 72.5
28 = 70

27 = 67.5
26 = 65
25 = 62.5
25 = 60

INSTRUCTOR'S SECTION

2. PRODUCT EVALUATION

CONVERSION TABLE

2. PRODUCT EVALUATION SCORE_____

EVALUATION SUMMARY

Posttest score = _____

INSTRUCTOR'S SECTION

3. WRITTEN EVALUATION

3. WRITTEN EVALUATION SCORE _____

EVALUATION WORKSHEET

1. Process evaluation score = _____
2. Product evaluation score = _____
3. Written evaluation score = _____
4. Total score = _____

Divide Total Score by 3 to find TLA score.

Total Score for TLA =

1 + 2 + 3 = Total Score

Total Score /3 = TLA SCORE

TLA SCORE _____

BIBLIOGRAPHY

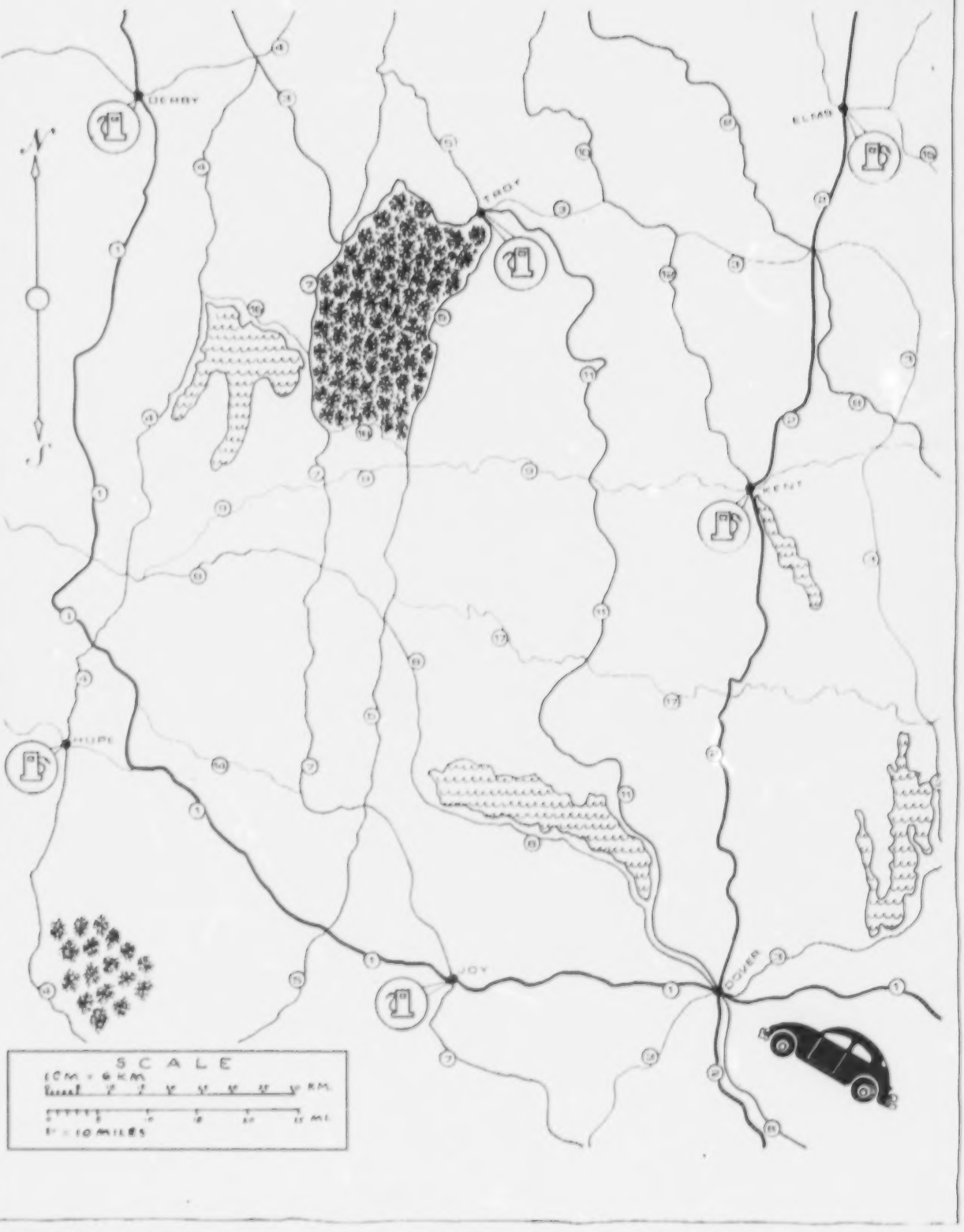
LEGO TC Logo Reference Guide. LEGO Group. LEGO DACTA Educational Products. Enfield, Connecticut, 1989.

Technic Control I Resource Guide. LEGO Group. LEGO DACTA Educational Products. Enfield, Connecticut, 1991.

Todd, Ronald D., David L. McCrory, and Karen L. Todd. *Understanding and Using Technology*. Davis Publications, Inc. Worcester, Massachusetts, 1985. Chapter 14, pp. 295-314.

INSTRUCTOR'S SECTION

HOW FAR?


DERBY
FROY
ELTAM
KENT
HUPS
JOY
COVER
SCALE
1CM = 6KM
KM
MI
1 = 10 MILES

TECHNOLOGY EDUCATION

TECHNOLOGY

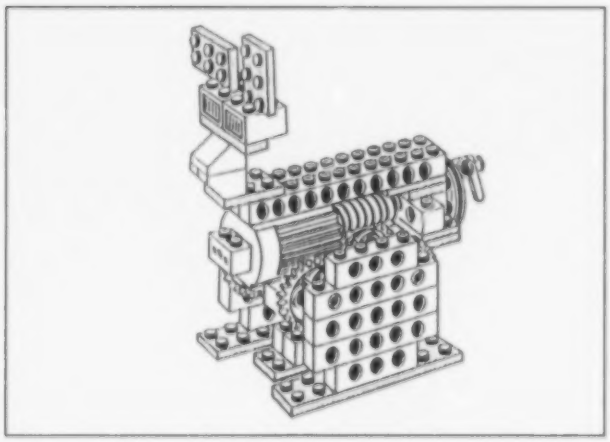
LEARNING

ACTIVITY

TE3112

CONTROL TECHNOLOGY

Suggested Time: 8 Days



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Oklahoma Department of Vocational and Technical Education

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TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

On Day 1 you should complete the following activities:

1. Complete Pretest
2. Read Assignments to Turn In (items to complete in 8 days)
3. Read Goal
4. Read Words You Should Know
5. Read Expected Learner Outcomes
5. Read Objectives
7. Read Related TSA Competitive Events
8. Read Academic and Workplace Applications

SUMMARY OF ACTIVITIES

Reading Comprehension Skills:
- Gain factual information
- Make generalizations

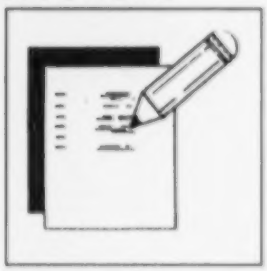
Functional Reading Skills:
- Follow written instructions
- Interpret graphics and symbols

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

PRETEST

INSTRUCTIONS



You will need a computer scan sheet or card to record your answers to the following Pretest. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet using a #2 pencil. Use rows 1-10 to record the answers to the Pretest. If your answers will be hand-scored, use a blank sheet of paper to record your answers and number your answers 1-10.

Get the Pretest Questions from your instructor.

When you finish the Pretest, return the test form and the computer scan card or notebook paper to your instructor.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

ASSIGNMENTS TO TURN IN

At the end of 8 days, you will have given the following items to your instructor for evaluation:

1. **Computer score card/sheet, with answers to:**
   - a) Pretest
   - b) Posttest

2. **Printouts of Programs**
   - a) Warning Lights
   - b) Stop and Go Car
   - c) Car and Lights
   - d) Sensational Wash
   - e) Trundle Wheel
   - f) Dogbot

3. **Career Search Activity**
   - a) Two occupations identified
   - b) Explanations of why those occupations appealed to you

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

GOAL

After completing the Control Technology TLA you will be able to construct and program computer controlled devices, using a LEGO DACTA® set and computer interface. You will understand how Control Technology affects you and your lifestyle.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

WORDS YOU SHOULD KNOW

Axle — A rod which is attached to the center of a wheel, gear, or pulley and turns with it.

Binary System — A system using a set of opposites to count or to control a system. All computers use binary systems, counting with 0 and 1. Other examples are on and off; true and false; and light and dark.

Debugging — Finding and fixing problems in a computer program or machine.

Force — A push or pull on an object. Gravity and friction are forces.

Gear Train — A set of gears used for changing the speed and force of rotating motion.

Interface Box — A device which connects lights, motors and sensors to the computer, and changes information so it can be used by a computer or by other equipment.

Logo — the name of a computer programming language. All programming languages translate human language into language computers can understand. You will be using a version called LEGO® TC Logo, which allows you to control LEGO motors, sensors and lights.

— continued —

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

WORDS YOU SHOULD KNOW

Port — A set of holes in the interface box. A port is an "inlet" if it receives information, or an "outlet" if it sends information.

Primitive — A simple Logo command. Primitives cannot be changed, but can be grouped to do new things. See Procedure.

Procedure — A set of commands which are combined as a new command.

Program — A list of computer commands which can be saved and used later.

Sensor — A device which collects information and sends it to a computer.

Subprocedure — A procedure used in other procedures.

Superprocedure — A procedure using other procedures.

Vehicle — A device for carrying people or things—a car, a device with caterpillar treads, bicycle, or anything else which can move.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

EXPECTED LEARNER OUTCOMES

- You will know and appreciate the importance of technology and technological literacy.
- You will explore career opportunities so you can make meaningful career choices.
- You will explore future educational opportunities so you can make meaningful educational choices.
- You will apply problem-solving and critical thinking techniques.
- You will apply math, science, reading, and other school subjects in a practical situation.
- You will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- You will recognize and develop individual talents.
- You will think logically and sequentially.

— continued —

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

EXPECTED LEARNER OUTCOMES

- You will develop leadership, creative abilities, positive self-concepts, and individual potential in a technological society.
- You will become a more sophisticated consumer of the goods and services of a technological society.
- You will adjust to a changing technological environment.
- You will develop an understanding and the ability to adapt to those technological forces that influence life in the 21st century.
- You will communicate by making clear and relevant points through the development of mental process skills.
- You will apply design, imagination and creative abilities.
- You will learn applications of lifelong learning skills.
- You will think globally and act locally.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

OBJECTIVES

At the completion of this Technology Learning Activity the student should be able to:

1. Build a light system and program it to control traffic lights, including turning on, turning off, waiting, and repeating.
2. Build a car and program it to move, stop, reverse direction, and speed up and slow down.
3. Build a car and warning lights and program the two systems together.
4. Build a "Sensational Wash" and program it, including using an optosensor to control the system.
5. Build a trundle wheel and program it, including using a tone to tell when the system ends the program.
6. Build a "Dogbot" and program it, including moving the Dogbot and playing music.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

The following TSA Competitive Event applies to your study of Control Technology:

Related TSA Competitive Events

- Control Technology

See *TSA Competitive Events Guidelines* for specific details on the competitions.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

The symbols in the right column are used to identify the Academic and Workplace Applications that are reinforced by specific activities in this TLA.

Reading Skills Applied:

Reading Comprehension Skills:

- ◆Gain factual information
- ◆Make generalizations
- ◆Distinguish fact, opinion, and inference

Functional Reading Skills:

- ◆Follow written instructions
- ◆Interpret graphics and symbols
- ◆Use content area vocabulary

Science Skills Applied:

General Science Skills:

- ◆Apply Computing Skills
- ◆Apply Technology

Physical Science Skills:

- ◆Apply Physical Laws
- ◆Investigate Forms of Energy

— continued —

DAY 1 ACTIVITIES

ACADEMIC AND WORKPLACE APPLICATIONS

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 1 ACTIVITIES

ACADEMIC AND WORKPLACE APPLICATIONS

Problem Solving Skills Applied:

Problem Solving Skills:

- ◆Apply New Technology
- ◆Evaluate Results
- ◆Devise a Solution
- ◆Apply Intuitive Thinking Techniques

If you complete Day 1 Activities with time left over, you may begin Day 2 Activities.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

On Day 2 you should complete the following activities:

1. Read Information Sheet
2. Complete Objective 1

SUMMARY OF ACTIVITIES

General Science Skills:
- Apply Computing Skills
- Apply Technology

Physical Science Skills:
- Apply Physical Laws
- Investigate Forms of Energy

Problem Solving Skills:
- Apply New Technology
- Evaluate Results
- Devise a Solution
- Apply Intuitive Thinking Techniques

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

INFORMATION SHEET

Every time a car moves, a bicycle wheel turns, or you go up a ramp, machines are making our lives easier. Machines affect almost everything we do, even though we do not always notice them around us.

Only 6 different simple machines exist. They are the lever, wheel and axle, pulley, inclined plane, wedge, and screw. These can be put together in combinations to make all other machines, even a car or an airplane.

Each of these simple machines makes work easier by doing more with less energy. Riding a bicycle to school is easier and faster than walking because of the mechanical advantage of the machines. (A bicycle uses two machines to create mechanical advantage: wheels and axles, and a pulley.)

Engineers can calculate the mechanical advantage of machines by using different formulas. The mechanical advantage is similar to the power of a machine, which is the amount of work done in a certain amount of time. We calculate the work as the force times the distance.

— continued —

EXAMPLE:
When you walk to school, you do a certain amount of work—you move yourself (force) to school (distance). If you ride your bike the amount of work is the same (force x distance) but the power is different.

Let's say it takes 20 minutes to walk but only 5 to ride. That means it took 4 times longer to do the work (going to school) without the mechanical advantage of the bicycle.

Using your bicycle you can use four times as much power as when you walk, without using any more energy. You notice this at school, because you are just as tired if you ride as if you walk.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

The energy needed to do work comes from many different sources. Sunlight, running water, wind, burning gasoline and the food you eat are all sources of energy.

The wind, running water and things which move have mechanical energy. Sunlight, burning gasoline and your food do not have mechanical energy because they do not move, but we can change the energy into mechanical energy.

If the sunlight makes an electric car move, if the gasoline is burned in an engine, if you pedal your bicycle, the energy becomes mechanical energy.

If we can use mechanical energy to do work, it is called mechanical power (or just power). The devices for using mechanical power are machines.

Machines can be very useful, if they are controlled, but if they aren't controlled they can be dangerous. Just think of a moving car without a driver or a bicycle you cannot steer or stop.

Machines can be controlled by people (like a bicycle), by the machine itself (like a fan which can only go at one speed and not faster), or by computers (like airplanes or manufacturing tools).

— continued —

Control Technology—using machines or computers to control other machines—is a complicated name for a simple idea. Control Technology really only turns devices on and off, at the right times.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

Just as you understand the difference between true and false, the computer understands the difference between on and off. However, until someone programs it, the computer doesn't understand anything but on and off. It doesn't understand 1, 2 and 3; it doesn't understand red, white and blue.

Computer programmers have taught the computer how to "think" almost as we do, by making Logo and other computer programming languages. As you use Logo you will see just how much the computer really can understand.

In the Control Technology TLA you will be building machines which do work. Additionally, you will use a computer to control the machines, to allow you to change what the machines do as easily as typing a new command into a computer.

DAY 2 ACTIVITIES

Because of these languages, we can talk to a computer in almost normal language. We can tell it to turn a light on, or turn it off. We can even tell it to wait for something to happen, and then turn the light off. Even the most complicated computer games are just fancy ways of turning switches on and off.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

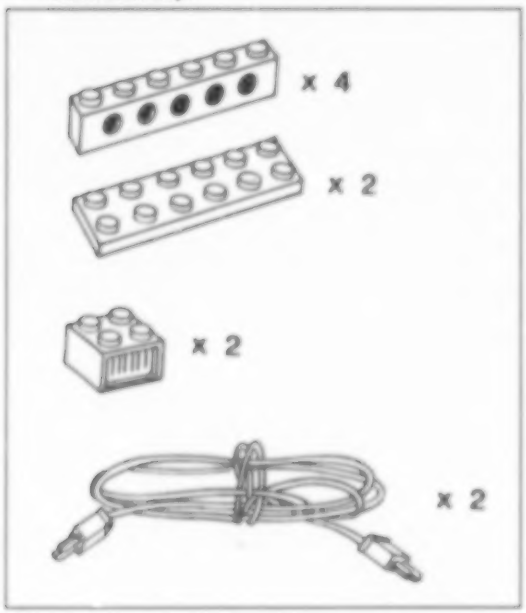
DAY 2 ACTIVITIES

OBJECTIVE 1

Build a light system and program it to control traffic lights, including turning on, turning off, waiting, and repeating.

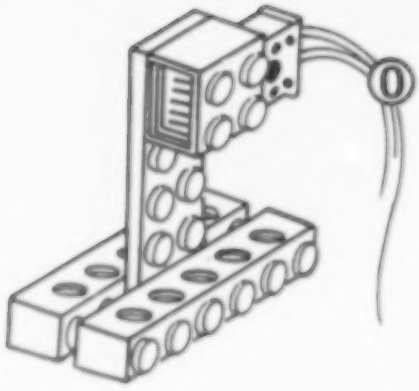
TOOLS AND MATERIALS

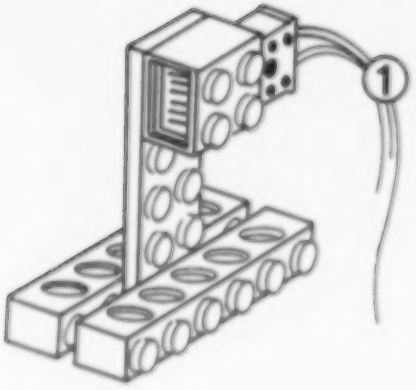
- LEGO DACTA® Technic Control I Set
- Computer with LEGO Interface Box
- LEGO TC Logo
- The following LEGO building elements (get them from your instructor):



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES





TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

INTRODUCTION

In this activity you will learn how to start the computer with the LEGO TC Logo software and LEGO Interface Box; learn how to connect lights to the Interface Box; and learn how to program the set using the LEGO TC Logo Command Center and Procedure Center.

PROCEDURE

FOLLOW THESE STEPS:

STEP 1: Follow your teacher's instructions to start LEGO TC Logo on your computer.

STEP 2: Plug in the Interface Box and make sure the red Stop button is up. If it is down, pushing it once will make it come back up. The red light over the Stop Button should be lit.

STEP 3: Build the lights as shown on the previous page.

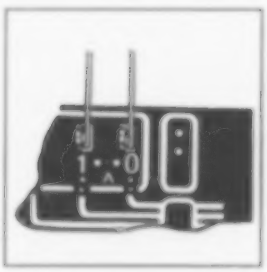
TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

FOLLOW THESE STEPS:

STEP 4: Plug a wire into each light.

STEP 5: Plug the other end of the wires into Port 0 and Port 1 on the Interface Box.



STEP 6: Using the arrow keys, position the bar on the computer screen over the words "New Page" and press Enter.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

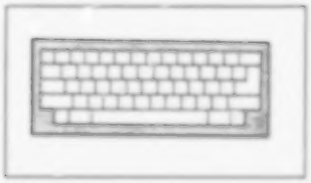
DAY 2 ACTIVITIES

FOLLOW THESE STEPS:

Some computers have a key called Enter, others have a key called Return, and others just have an arrow pointing left with a bend near the end. All of these keys do the same thing. In this manual the key will always be called Enter.

You will normally have to press Enter after typing something, so the computer will know you are finished. From now on the instructions in this TLA will not tell you to press Enter each time.

STEP 7: Make sure that the flashing box (the cursor) is in the area at the bottom of the screen. If it is at the top, press CTRL-D if you have an IBM, or OA-D (Open-Apple-D) if you have an Apple.



STEP 8: Type:

talkto 0

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

FOLLOW THESE STEPS:

STEP 9: Type: **on**

The light connected to Port 0 should be on. If it isn't, check to see that you typed everything correctly, that the Interface Box is plugged in, and that the wire connected to Port 0 also connects to a light.

STEP 10: Type the following commands, and watch the lights. You should type the dark words in the right column. The sentences in the left column tell you what the command does.

This tells the computer to talk to Port 1.	**talkto 1**
This turns the light on.	**on**
Tells the computer to talk to Port 0.	**talkto 0**
Turns Port 0 off.	**off**
Talks to Port 1.	**talkto 1**
Turns Port 1 off.	**off**

The symbols [and] are not parentheses. They are brackets with square corners. If you type parentheses (using the shift key and the 9 and 0 keys), the commands will not work.

Tells the computer to talk to Port 0 and 1.	**talkto [0 1]**
Turns on both Port 0 and Port 1.	**on**
Turns off both Port 0 and Port 1.	**off**
Turns both Port 0 and Port 1 on for 1 second. (10 tenths of a second)	**onfor 10**

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

FOLLOW THESE STEPS:

You can use the square brackets [ ] to make lists. In the above example you listed Port 0 and Port 1, so the computer would talk to both of them at once. You can also list commands and have the computer REPEAT them.

STEP 11: Type:

repeat 8 [onfor 10 wait 10]

This makes a flashing light. The lights go on for one second, then the computer waits for one second (with the lights off) then the cycle repeats 7 more times for a total of 8 cycles.

STEP 12: Make up a command to make both lights turn on for 1 second, wait for 2 seconds, and repeat both steps three times.

All of the commands you have used so far (on, off, talkto, onfor, and wait) are called primitives. They only do one thing. You can make up new procedures for the computer, using what you already know.

STEP 13: Press CTRL-U if you have an IBM PC or OA-U (Open-Apple-U) if you have an Apple Computer.

CTRL-U

-U

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

FOLLOW THESE STEPS:

Your flashing cursor should be at the top of your screen. This part of the screen is called the Procedure Center, because Procedures are typed into this area.

STEP 14: Type the following commands:

names the procedure

to blink

tells the computer the procedure is over

repeat 8 [onfor 10 wait 10]
end

STEP 15: Using either CTRL-D or OA-D (Open-Apple-D), move to the bottom of the screen.

This is the part called the Command Center, because commands are carried out here.

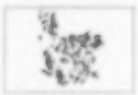
STEP 16: Type:

blink

Now you have made a new procedure called blink. If you want the lights to blink, you just have to type the one word, instead of the entire list of commands. Also, if you want to change part of the procedure, you do not have to retype the entire thing.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES



FOLLOW THESE STEPS:

STEP 17: Go back to the top of the screen (the Procedure Center) and change "wait 10" to "wait 5". Use the arrow keys to move to the 10, then use the Delete (Del) key and the Backspace arrow at the top right of the main keyboard to erase the 10, then type a 5. The new procedure should look like the one in the right column.

```
to blink
repeat 8 [onfor 10 wait 5]
end
```

STEP 18: Move to the Command Center and type:

```
blink
```

STEP 19: Move up to the Procedure Center and place the cursor at the beginning of the last line.

STEP 20: Press ENTER to create a new line, press the left arrow once, then type:

```
blink
```

STEP 21: Go down to the Command Center and type:

```
blink
```

The new procedure should look like this:

```
to blink
repeat 8 [onfor 10 wait 5]
blink
end
```

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

FOLLOW THESE STEPS:

The lights will keep doing the blink procedure over and over, or until you tell the computer to stop, because the procedure includes its own name as a procedure. This is called a recursive procedure and is often used for tasks which must be repeated often—like stop lights. To stop the computer when it is in the middle of a procedure (or doing anything else) just press CTRL-S (on the IBM) or OA-S (on the Apple).

LEGO TC Logo has other ways to stop a program. If the machine is about to damage something (or itself), you can push the red STOP button on the Interface Box to cut off the power to the machine. Then you will have to press CTRL-S (or OA-S) to stop the program itself.

If something is still on after pressing CTRL-S (or OA-S), you can type ALLOFF to turn everything off.

Before you can run another procedure, you must push the red STOP button again to restore power to the ports.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

FOLLOW THESE STEPS:

STEP 22: Your task is to write a different procedure, called "walk", to help students cross the street. The procedure should have one light for the cars and one light for the students. The lights should light to show that it is OK to move (like a green light). The students should have 10 seconds to cross the street, and then the light should blink for 2 seconds to warn them that the light is about to change. The cars should have 15 seconds to drive and 5 seconds of blinking lights to warn that they are about to change.

STEP 23: When you finish, have your instructor check your results.

STEP 24: You need to name and save your page. Select a name, such as "warning". Type: np "warning

The " in the other column is a set of double quotes—not a fat single quote.

STEP 25: Now press the key labeled Escape or ESC. ESC

You are now back at the menu you started at. The page you just named is one of the choices listed, in addition to New Page and a few others.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 2 ACTIVITIES

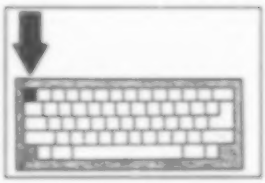
FOLLOW THESE STEPS:

STEP 26: Move the cursor to the name of your page and press ENTER to return to the Procedure Center and Command Center.

ENTER

STEP 27: After your page has been saved, you need to print it. Ask your instructor for help getting the printer ready to print. Set the printer up. Move into the Command Center and type:

printtext



STEP 28: Now that your program has been printed, you can press Escape to return to the menu, or you can continue improving your program.

After you have named your page, it will be saved each time you press Escape to return to the Menu.

STEP 29: When you are finished, take the warning lights apart and put the pieces where they belong. Turn off your computer.

If you finish Day 2 Activities with time left over, you may begin Day 3 Activities.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 3 ACTIVITIES

On Day 3 you should complete the following activity:

1. Complete Objective 2

SUMMARY OF ACTIVITIES

General Science Skills:
- Apply Computing Skills
- Apply Technology

Physical Science Skills:
- Apply Physical Laws
- Investigate Forms of Energy

Problem Solving Skills:
- Apply New Technology
- Evaluate Results
- Devise a Solution
- Apply Intuitive Thinking Techniques

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 3 ACTIVITIES

OBJECTIVE 2

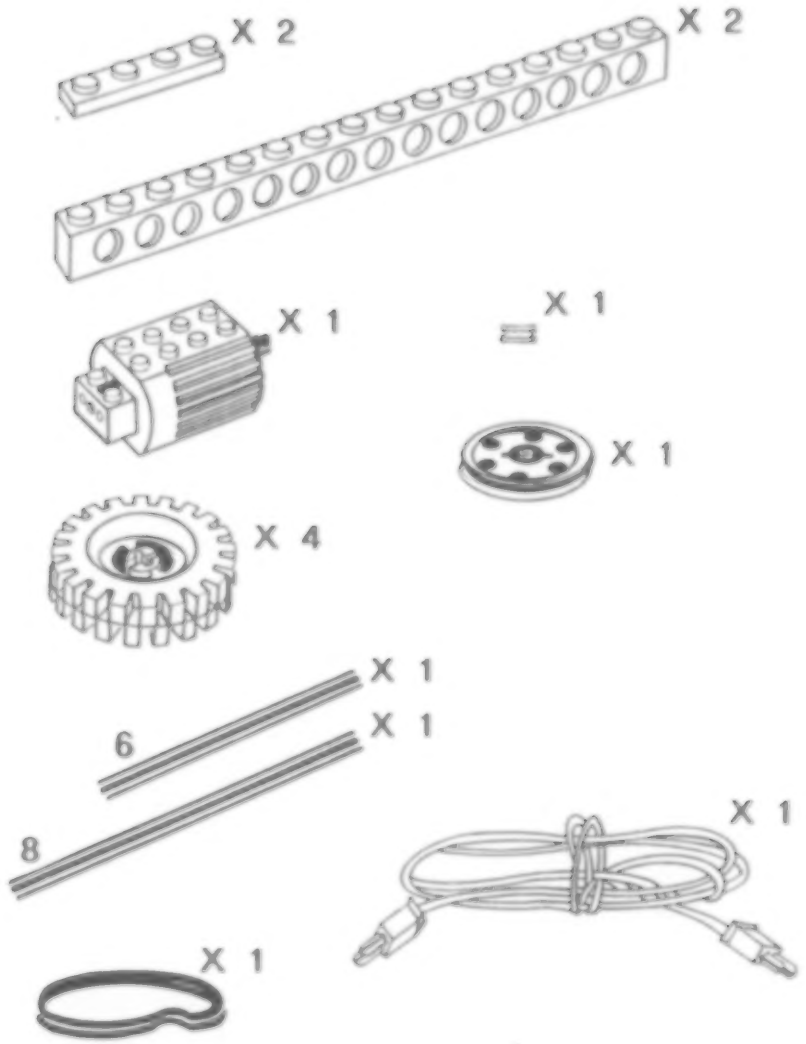
Build a car and program it to move, stop, reverse direction, and speed up and slow down.

TOOLS AND MATERIALS

- LEGO DACTA® Technic Control I Set
- Computer with LEGO Interface Box
- LEGO TC Logo
- The LEGO building elements on the following page (get them from your instructor):

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 3
ACTIVITIES



TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 3 ACTIVITIES

INTRODUCTION

Many computer controlled systems use only on and off to control the devices. Conveyor belts, gates for irrigation ditches, and river locks are simple on and off systems.

Some of these systems can simply repeat over and over until they are stopped — "closed loops" do this. They can also respond to things that they do or sense. For example, a washing machine stops when someone opens the door or when the timer runs out. In this case the system responds to "feedback."

Some more complex systems allow speed to be controlled. Cars have on and off controls for direction, and can also control the speed in either direction.

Today you will write a procedure to move a car for a distance, reverse the direction, and move it back. You will also learn to control the speed of the car.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 3 ACTIVITIES

PROCEDURE

FOLLOW THESE STEPS:

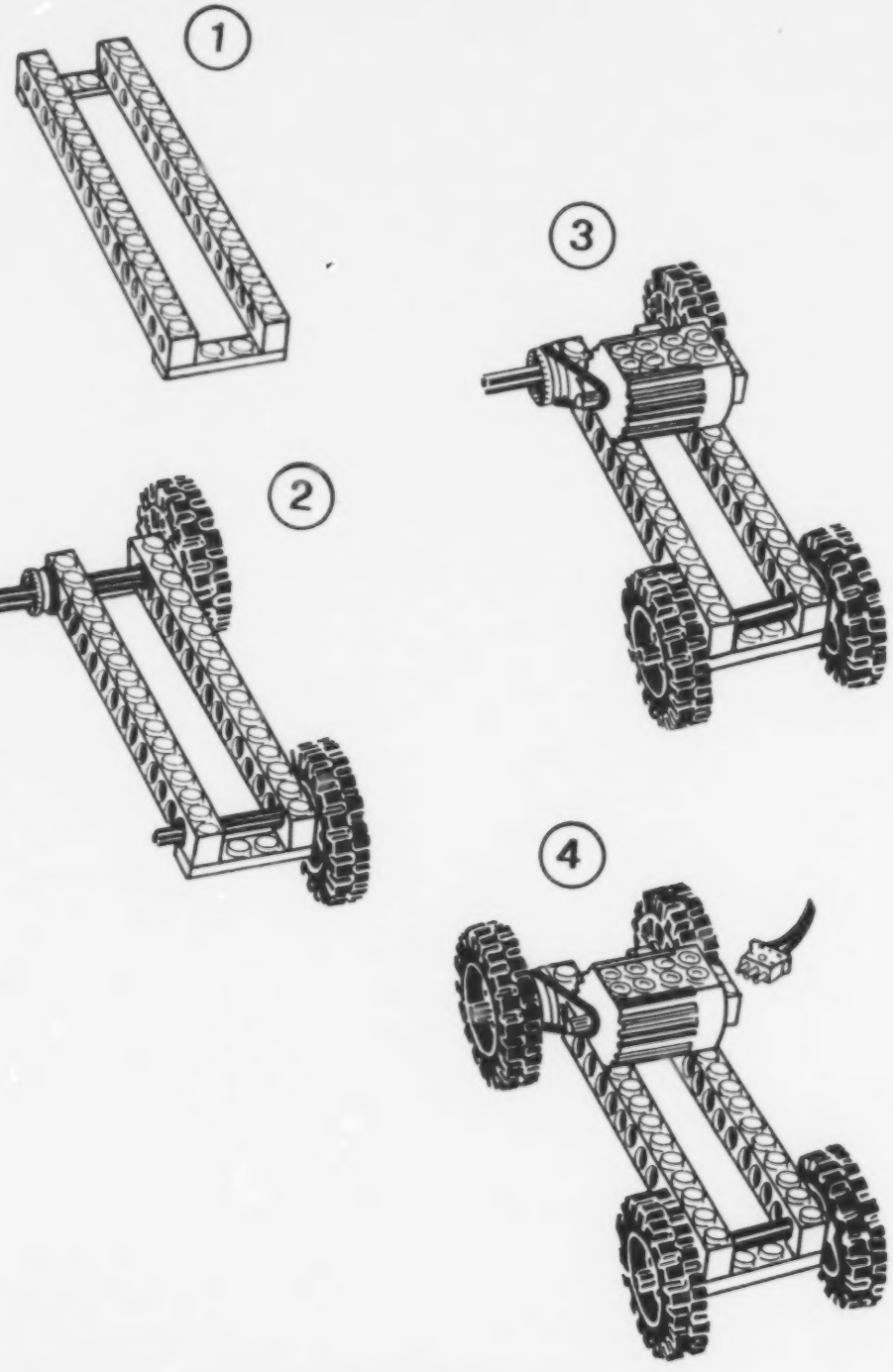
STEP 1: Follow your teacher's instructions to start LEGO TC Logo on your computer.

STEP 2: Plug in the Interface Box and make sure the red Stop button is up. The red light over the Stop Button should be lit.

STEP 3: Build the car shown on the following page.

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 3
ACTIVITIES



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

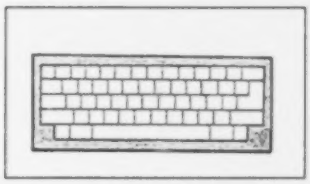
DAY 3 ACTIVITIES

FOLLOW THESE STEPS:

STEP 4: Position the bar over "New Page" on the first screen of LEGO TC Logo. Press return.

STEP 5: Plug the wire into the motor and into Port A. That is the Port between 0 and 1.

The motors can be controlled just like lights, but there are also extra commands for the motor.



STEP 6: Go to the Command Center (the bottom part of the screen) and type:

talkto "a

The set of quotes are needed before talking to a letter port. Without the quotes the computer will think it is supposed to do a procedure called a. If this happens and there isn't a procedure called a, you will see "I don't know how to a" on the screen.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 3 ACTIVITIES

FOLLOW THESE STEPS:

STEP 7: Type the following commands and watch the results.

The commands are in the right column and the explanations are in the left.

	onfor 5
changes the direction of the motor	**rd**
	onfor 5
	rd
sets the power	**setpower 4**
	onfor 5

The command setpower must be followed by a number between 1 and 7. 1 is the lowest power and 7 is the highest.

STEP 8: Move up into the Procedure Center and write a procedure called "move" to move the car for 1 second, to reverse the direction, and to move it back for 1 second. You should also include a setpower statement to reduce the power, so the car goes slower and doesn't run out of power cable.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 3
ACTIVITIES

FOLLOW THESE STEPS:

Sometimes it is necessary to know which direction the car is going to move, so there are two extra commands to control the direction of the motor. These are "seteven" and "setodd". One will turn the motor in one direction, and the other will turn the motor the opposite way. With these you can know which way the car will move at the beginning of the procedure, and not just that it will move the opposite direction from last time.

STEP 9: Change your move procedure to use one of the new commands at the beginning and the other in the middle. Be sure the car moves forward at the start and backward at the end.

STEP 10: Try your new procedure.

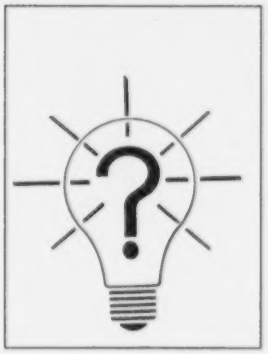
Computer programmers often write programs with many small sections, called sub-routines or sub-procedures, instead of just one big procedure. Each of these small sections does just one thing, so it is easier to test it out. Then, once all of the sub-routines work, it is time to test the whole thing together.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 3 ACTIVITIES

FOLLOW THESE STEPS:

STEP 11: Rewrite your "move" procedure to have a "move" subprocedure to go forward; a "backup" subprocedure to go backwards; and a "car" superprocedure including both of the sub-routines.



STEP 12: Test each of the subprocedures, then test the whole program. The results should be the same as before the subprocedures were added.

STEP 13: Modify your program again to make the car goes forward and backward, forward and backward, continuously.

STEP 14: When you finish, have your instructor check your results.

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 3 ACTIVITIES

FOLLOW THESE STEPS:

STEP 15:	You need to name and save your page. Select a name and type:	np "*name*
STEP 16:	Now press the key labeled Escape or ESC.	ESC
STEP 17:	Move the cursor to the name of your page and press ENTER to return to the Procedure Center and Command Center.	ENTER
STEP 18:	Set the printer up (get your instructor's help if needed). Move into the Command Center and type:	printtext
STEP 19:	Return all of the LEGO pieces to your instructor; show your instructor the printout of your page; and make sure everything in your area has been put away. Turn off your computer.	

If you complete Day 3 Activities with time left over, you may begin Day 4 Activities.

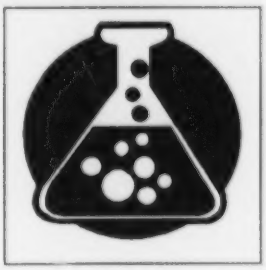
TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 4 ACTIVITIES

On Day 4 you should complete the following activity:

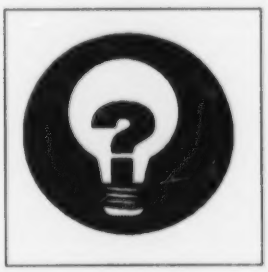
1. Complete Objective 3

SUMMARY OF ACTIVITIES



General Science Skills:
- ◆Apply Computing Skills
- ◆Apply Technology

Physical Science Skills:
- ◆Apply Physical Laws
- ◆Investigate Forms of Energy



Problem Solving Skills:
- ◆Apply New Technology
- ◆Evaluate Results
- ◆Devise a Solution
- ◆Apply Intuitive Thinking Techniques

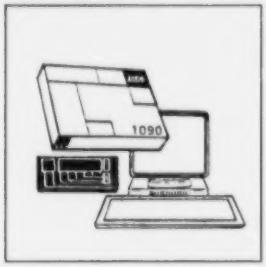
TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 4 ACTIVITIES

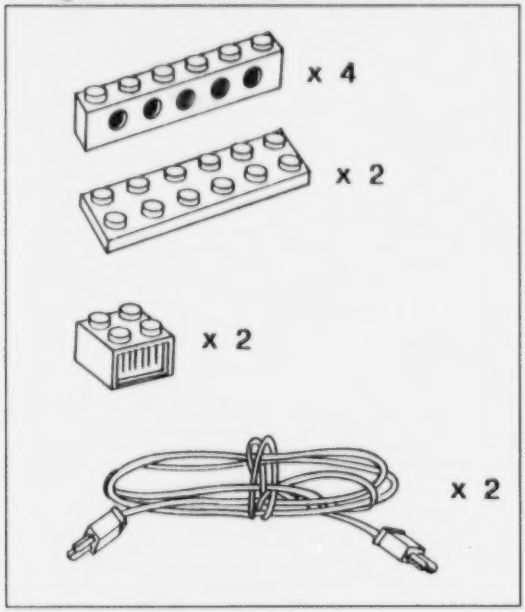
OBJECTIVE 3

Build a car and warning lights and program the two systems together.

TOOLS AND MATERIALS

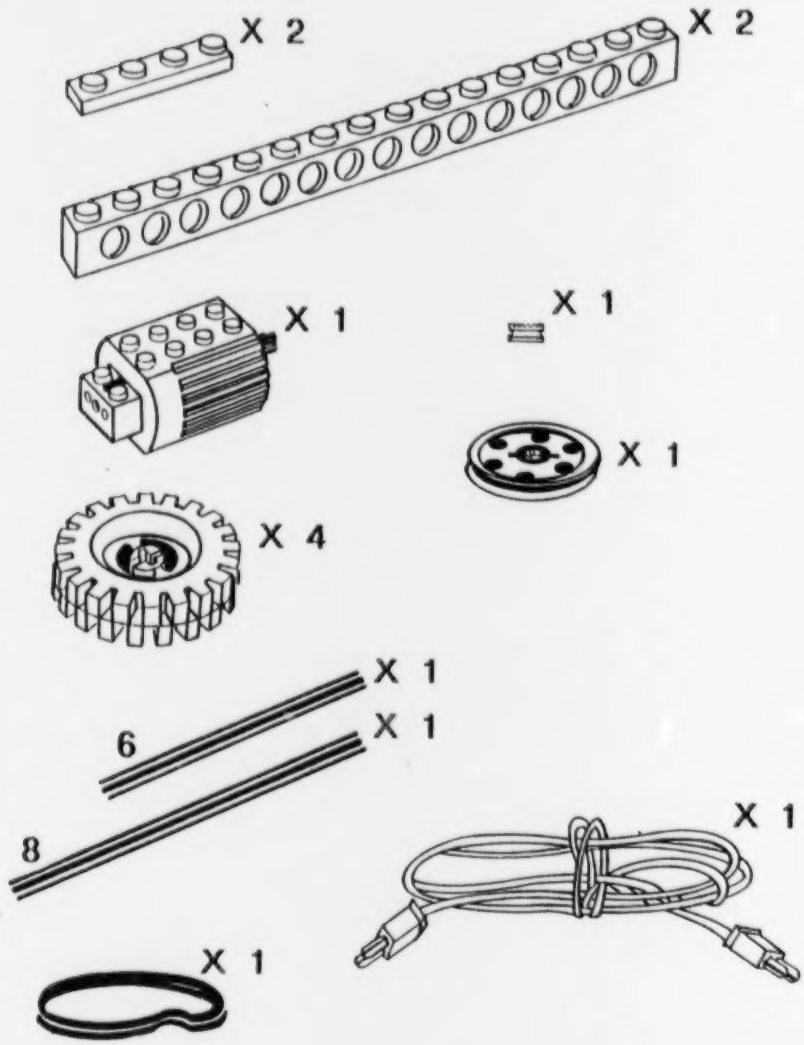


- LEGO DACTA® Technic Control I Set
- Computer with LEGO Interface Box
- LEGO TC Logo
- The LEGO building elements below and the elements on the next page (get them from your instructor):



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 4 ACTIVITIES



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 4 ACTIVITIES

INTRODUCTION

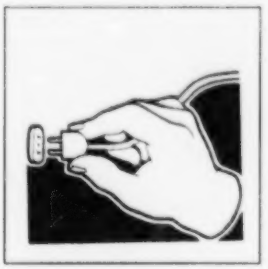
Many Control Technology Systems control more than one device at a time. Railroad crossing warnings are a good example of this—the lights flash (device 1) and the motor makes the arms go down (device 2).

PROCEDURE

FOLLOW THESE STEPS:

STEP 1: Follow your teacher's instructions to start LEGO TC Logo on your computer.

STEP 2: Plug in the Interface Box and make sure the red Stop button is up. The red light over the Stop Button should be lit.

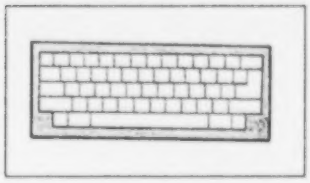


STEP 3: Rebuild your car from yesterday and the lights from Day 2. You do not have to build them exactly as you did before, but they must work and you must do them quickly enough that you have time to do everything in today's assignment.

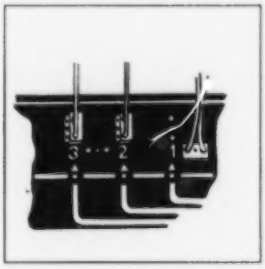
TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 4 ACTIVITIES

FOLLOW THESE STEPS:



STEP 4: Plug the lights into Ports 2 and 3, and plug the motor into Port A.



In the command center type:

talkto [2 3]
flash 5 5

The flashing will continue until you tell it to stop. You can type "off" and make the flashing stop, or, if you are writing a procedure, you can use a wait command, then turn the light off.

STEP 5: Move to the Procedure Center and type the following:

to warn
talkto [2 3]
flash 5 5
wait 50
off
end

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 4 ACTIVITIES

FOLLOW THESE STEPS:

STEP 6: Try the procedure you just made. Experiment with the numbers after the word "flash" until you know what each one does.

Next you will program your system to operate the motor and the lights.

STEP 7: Program your car, using three subprocedures—one for movement in each direction and a third for pausing between the moves. The car should move forward about 1 foot, or the height of this book, pause for 5 seconds and move back.

STEP 8: Now write a subprocedure to turn the lights on and another to turn the lights off.

STEP 9: Test all of the subprocedures and make sure they work the way you want them to work.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 4 ACTIVITIES

FOLLOW THESE STEPS:

STEP 10:	Now write a superprocedure, using subprocedures as much as possible. The lights should come on, then the car should move, stop, and then the lights should go off. There should be a 5 second delay, then the lights should go on, the car should move the other direction, and the lights should go off.	
STEP 11:	You need to name and save your page. Select a name and type:	np "*name*
STEP 12:	Now press the key labeled Escape or ESC.	ESC
STEP 13:	Move the cursor to the name of your page and press ENTER to return to the Procedure Center and Command Center.	ENTER
STEP 14:	Set the printer up (get your instructor's help if needed). Move into the Command Center and type:	printtext

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 4 ACTIVITIES

FOLLOW THESE STEPS:

STEP 15: Return all of the LEGO pieces to your instructor and make sure everything in your area has been put away. Turn off your computer.

If you complete Day 4 Activities with time left over, you may begin Day 5 Activities.

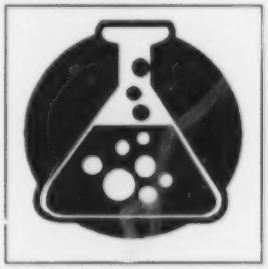
TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 5 ACTIVITIES

On Day 5 you should complete the following activities:

1. Complete Objective 4

SUMMARY OF ACTIVITIES



General Science Skills:
- ◆Apply Computing Skills
- ◆Apply Technology

Physical Science Skills:
- ◆Apply Physical Laws
- ◆Investigate Forms of Energy

Problem Solving Skills:
- ◆Apply New Technology
- ◆Evaluate Results
- ◆Devise a Solution
- ◆Apply Intuitive Thinking Techniques

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 5 ACTIVITIES

OBJECTIVE 4

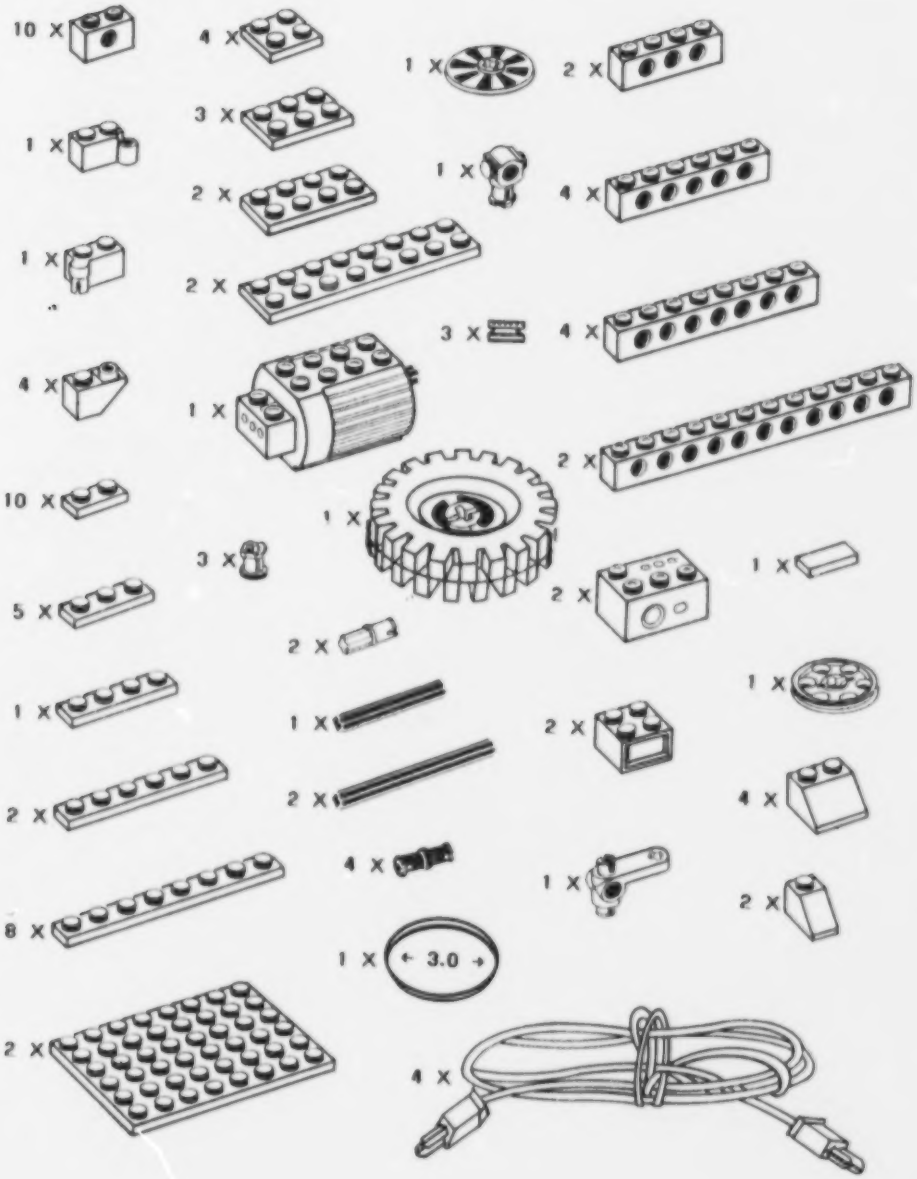
Build a "Sensational Wash" and program it, including using an optosensor to control the system.

TOOLS AND MATERIALS

- LEGO DACTA® Technic Control I Set
- Computer with LEGO Interface Box
- LEGO TC Logo
- The LEGO building elements shown on the next page (get them from your instructor):

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 5
ACTIVITIES



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 5 ACTIVITIES

INTRODUCTION

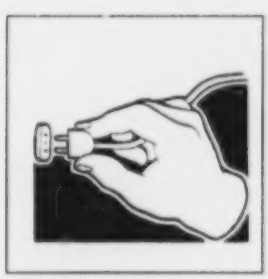
Control Technology systems use sensors to report information to the computer about the system or its surroundings. You will use an optosensor to report information seen by the sensor to your computer. Remote control TVs and VCRs have optosensors, as do automatic garage door openers and the automatic price readers in the supermarket.

PROCEDURE

FOLLOW THESE STEPS:

STEP 1: Follow your teacher's instructions to start LEGO TC Logo on your computer.

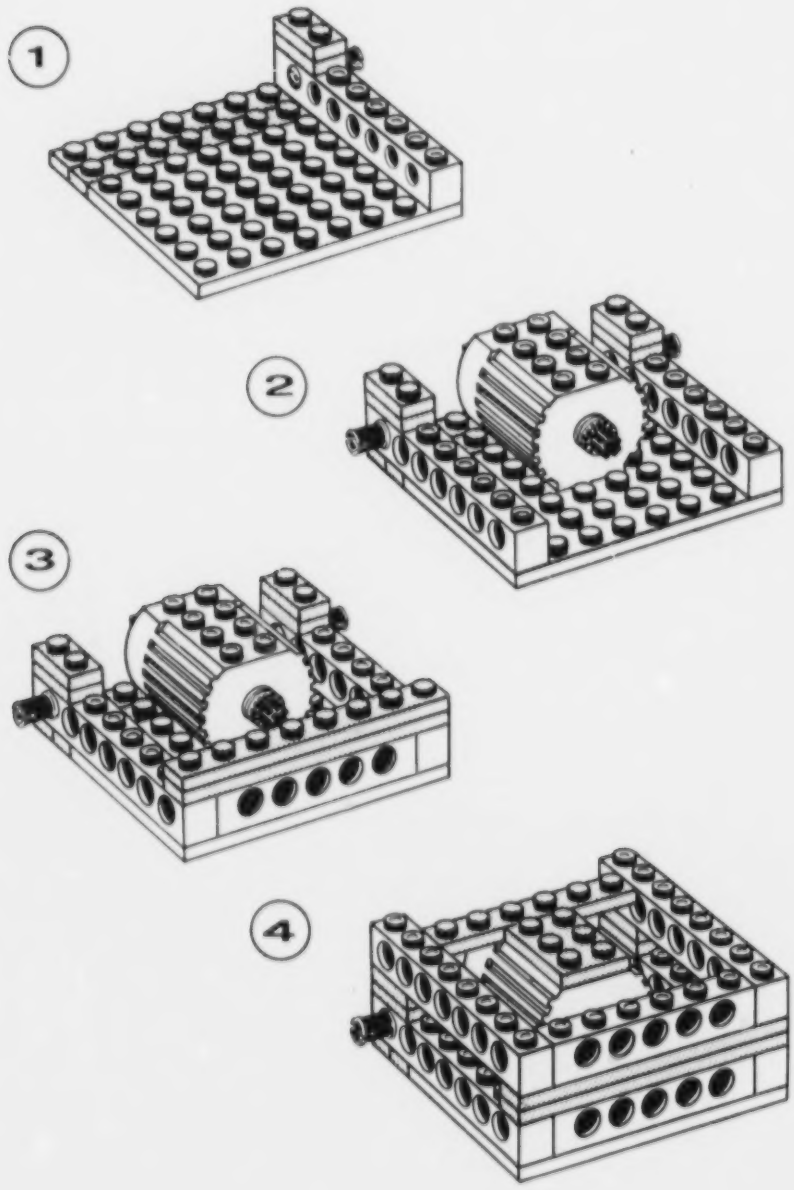
STEP 2: Plug in the Interface Box and make sure the red Stop button is up. The red light over the Stop Button should be lit.



STEP 3: Build the "Sensational Wash" exactly as shown.

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

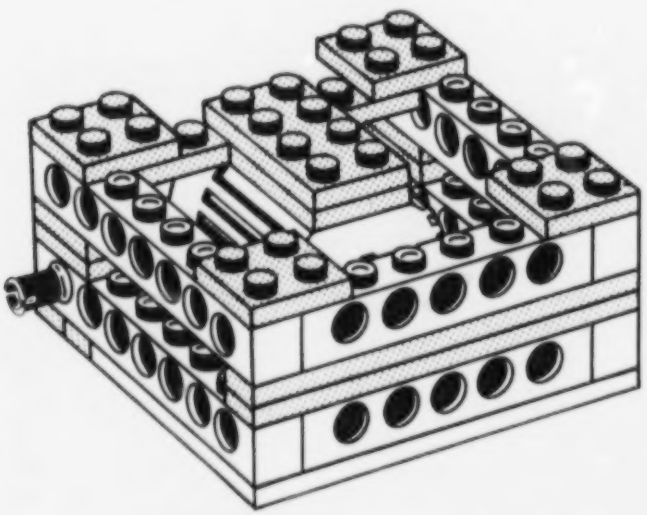
DAY 5
ACTIVITIES



TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 5
ACTIVITIES

5



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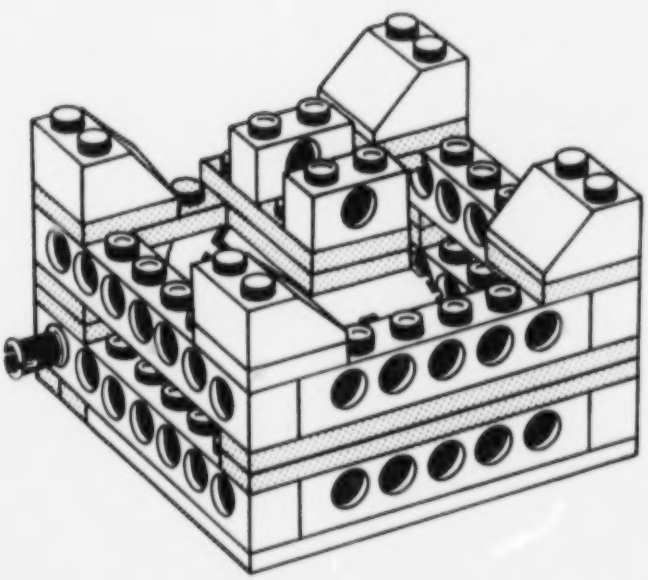
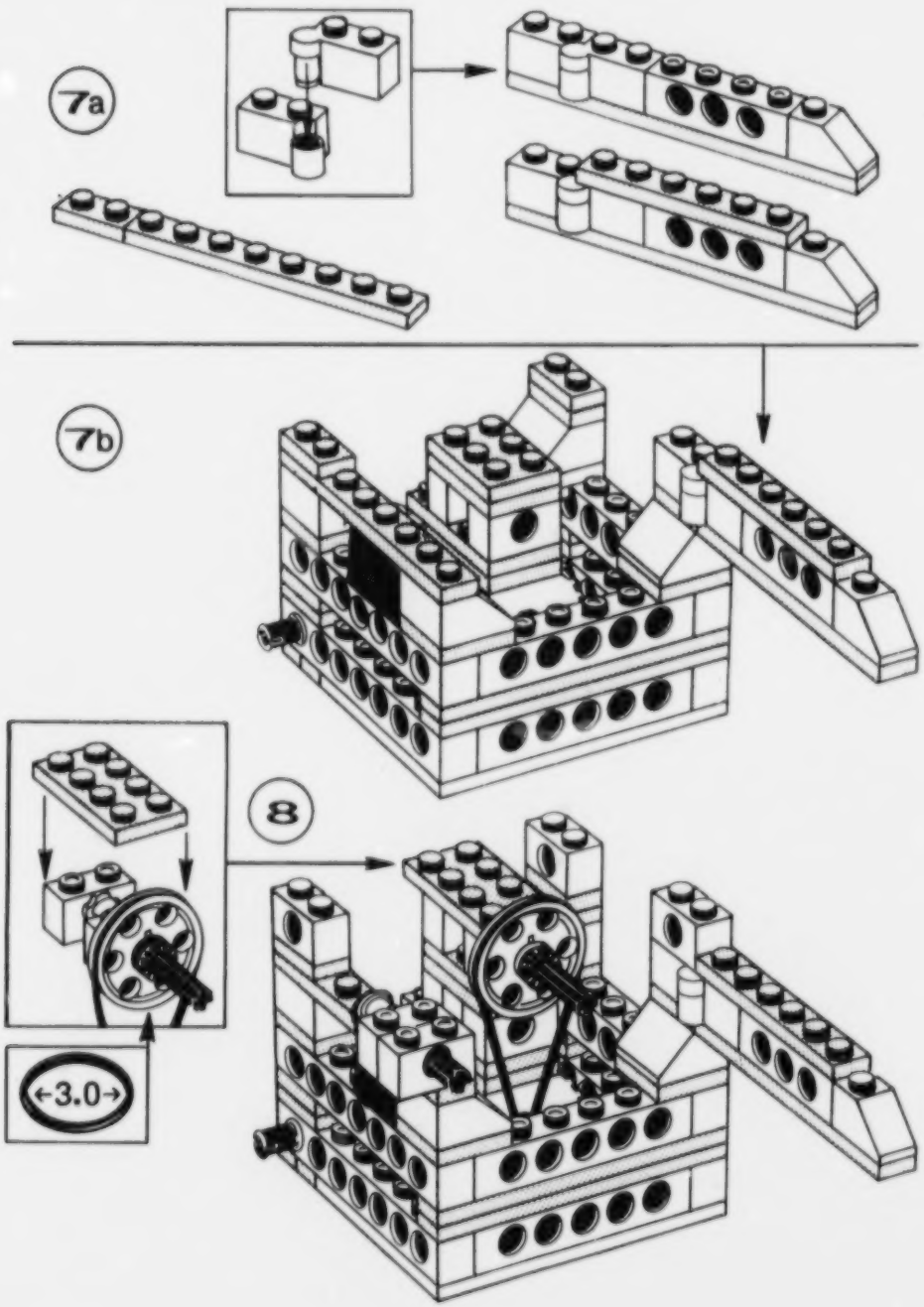


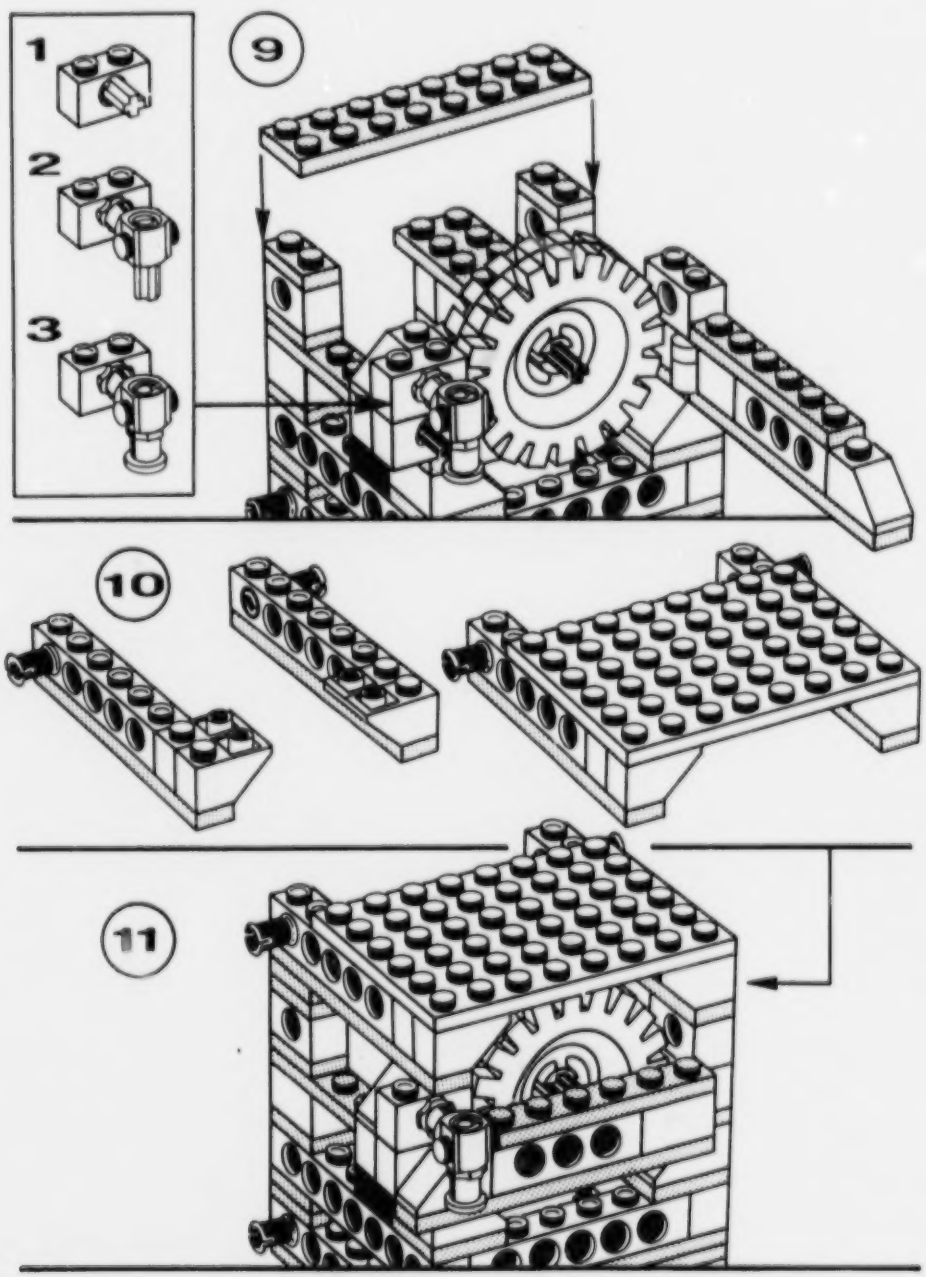
TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 5 ACTIVITIES



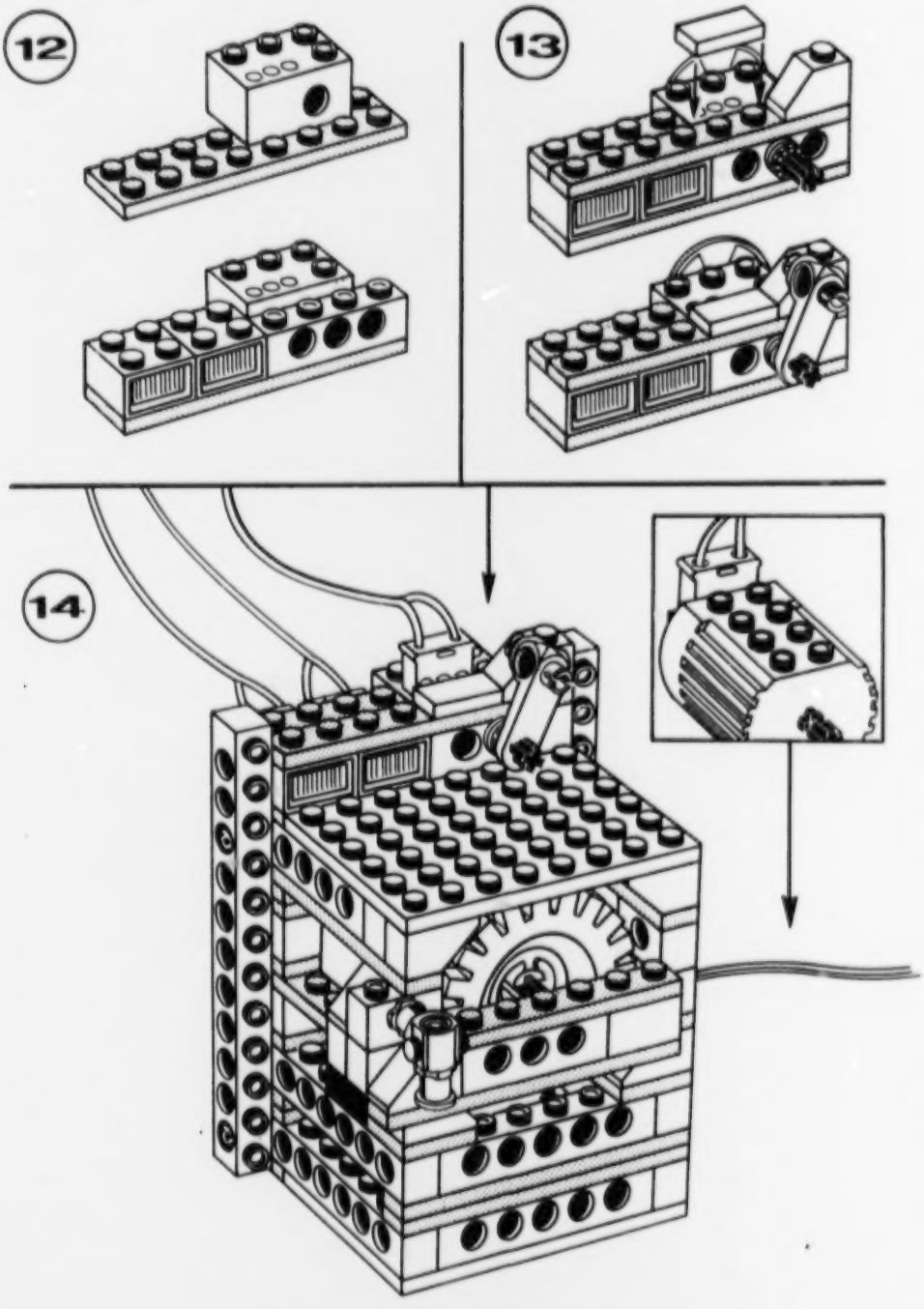
TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 5 ACTIVITIES



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

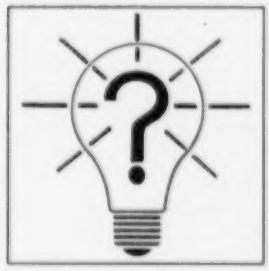
DAY 5 ACTIVITIES



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 5 ACTIVITIES

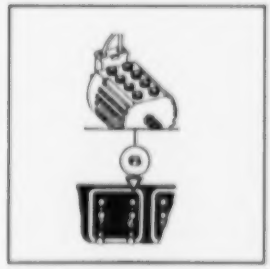
FOLLOW THESE STEPS:



STEP 4: Now you will start programming the Sensational Wash. Write a sub-routine called "wash" which moves the wheel back and forth repeatedly for 20 seconds. An indicator light should be on during this time.

STEP 5: Write a sub-routine called "spin" which spins in one direction for 15 seconds. The other indicator light should be on for this.

STEP 6: Combine the sub-routines into a larger procedure, called laundry, including a pause between the cycles.

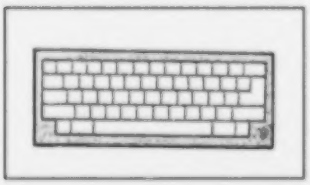


STEP 7: Find an optosensor (black box with outlet and two holes on the side.) Plug a wire into the sensor and into Port 6 on the Interface Box.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

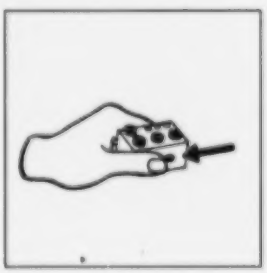
DAY 5 ACTIVITIES

FOLLOW THESE STEPS:



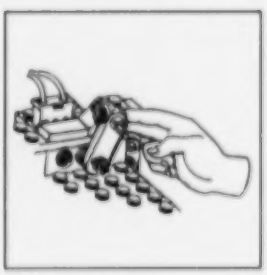
STEP 8: In the Command Center, type: **listento 6**

STEP 9: Using your thumb, cover the small hole on the side opposite the plug. Uncover it and cover it several times, watching the green light on the Interface box. It should go on (or off) whenever the hole is covered.



The optosensor is sensitive to the change between light and dark, and can be used with the black and white wheels in the LEGO Set to count and to tell the computer information about a system.

STEP 10: Connect the optosensor on top of the washing machine to Port 6. Cover the sensor with your hand and uncover it repeatedly. The light on the Interface Box should be on when the sensor sees dark and off when the sensor sees light.



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 5 ACTIVITIES

FOLLOW THESE STEPS:

If the green light on the Interface Box is on when the sensor sees light, you need to unplug the sensor, then cover the hole with your finger and plug it back in.

STEP 11: Move down to the Command Center. Type:

listento 6 show sensor?

This will tell you if the sensor is in a true (seeing dark) or false (seeing light) state. The primitive "sensor?" tells the computer about the state of the sensor. Using the primitive "show" before "sensor?" puts the information on the the computer screen, so you can see the results.

It is possible to use the sensor as a switch, by reporting to the computer, instead of the screen.

STEP 12: In the Command Center, type:

listento 6 waituntil [sensor?] talkto "a onfor 40

STEP 13: Build the sub-assembly shown and install it on the "Sensational Wash" as shown.

STEP 14: Add a subprocedure to your program which only starts the washer when the switch is on.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 5 ACTIVITIES

FOLLOW THESE STEPS:

STEP 15:	Try your program. Fix any problems, until it works perfectly.	
STEP 16:	When you finish, have your instructor check your results.	
STEP 17:	You need to name and save your page. Select a name and type:	np "*name*
STEP 18:	Now press the key labeled Escape or ESC.	ESC
STEP 19:	Move the cursor to the name of your page and press ENTER to return to the Procedure Center and Command Center.	ENTER
STEP 20:	Set the printer up (get your instructor's help if needed). Move into the Command Center and type:	printtext

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 5 ACTIVITIES

FOLLOW THESE STEPS:

STEP 21: Return all of the LEGO pieces to your instructor and make sure everything in your area has been put away. Turn off your computer.

If you complete Day 5 Activities with time left over, you may begin Day 6 Activities.

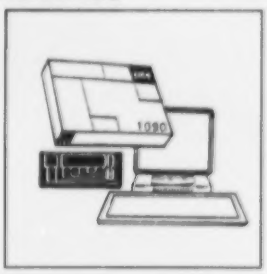
TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 6 ACTIVITIES

OBJECTIVE 5

Build a trundle wheel and program it, including using a tone to tell when the system ends the program.

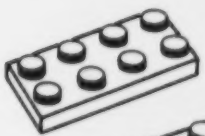
TOOLS AND MATERIALS



- LEGO DACTA® Technic Control I Set
- Computer with LEGO Interface Box
- LEGO TC Logo
- Map (get it from your instructor)
- The LEGO building elements shown on the next page (get them from your instructor):

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 6
ACTIVITIES

2 x 

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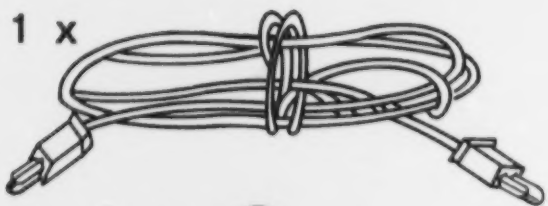
1 x 

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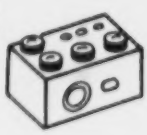
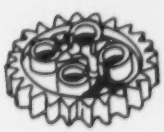
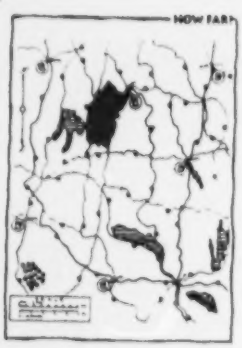
1 x 

1 x 

1 x 

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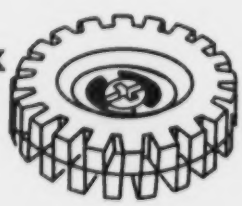
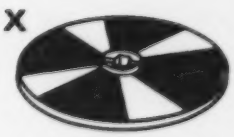
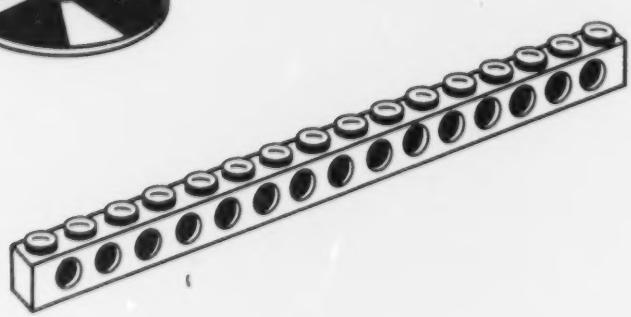
1 x 

1 x 

1 x 

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 6 ACTIVITIES

INTRODUCTION

Control Technology systems use optosensors to count as well as to switch devices on and off. Some examples include speedometers and odometers in cars, which count how often the wheel goes around and how far the car goes.

These devices are trundle wheels. Trundle wheels are used to measure by counting the rotations of a wheel. Policemen use trundle wheels at the scene of accidents, to measure distance.

FOLLOW THESE STEPS:

STEP 1: Follow your teacher's instructions to start LEGO TC Logo on your computer.

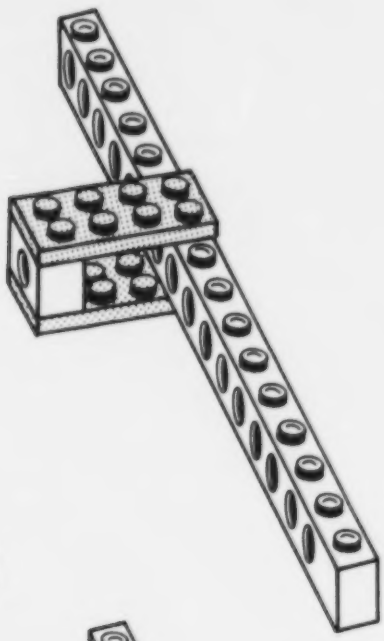
STEP 2: Plug in the Interface Box and make sure the red Stop button is up. The red light over the Stop Button should be lit.

STEP 3: Build the trundle wheel exactly as shown. Be sure to mount the counting wheel with 8 sections facing the optosensor.

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 6
ACTIVITIES

1



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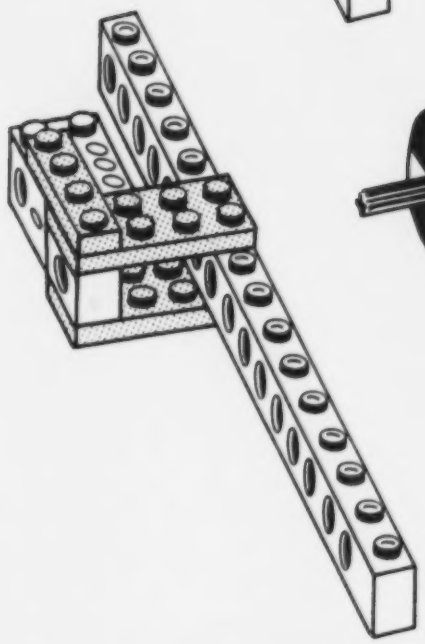

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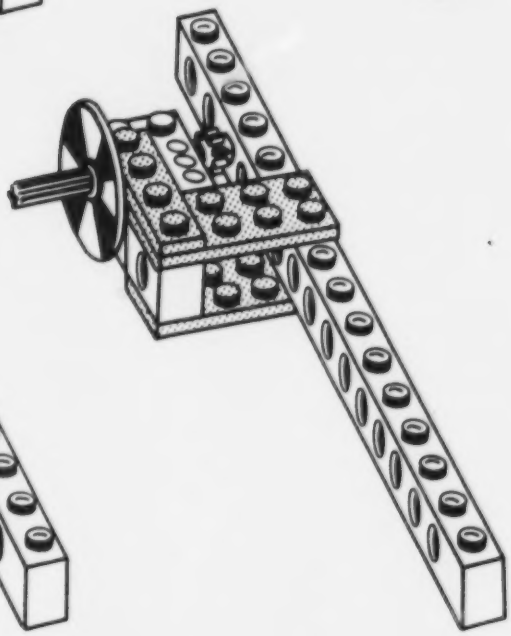
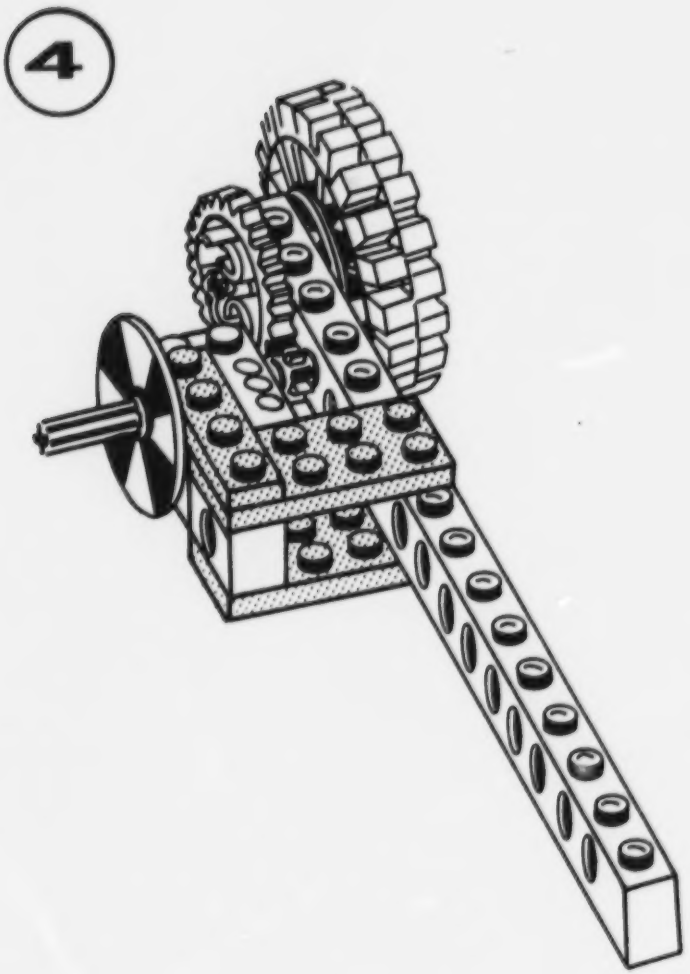


TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 6
ACTIVITIES

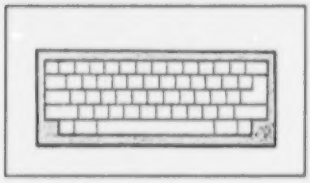


TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

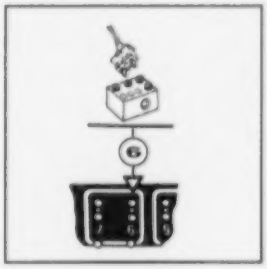
DAY 6 ACTIVITIES

FOLLOW THESE STEPS:

LEGO TC Logo has a built-in counter which shows the number of times the optosensor changes from on to off. The following procedure will show how this works.



STEP 4: Plug the wire into the optosensor and into Port 6.



In the Procedure Center, type:

```
to mapcount
listento 6
resetc
wait 50
show counter
end
```

Resets the counter

Shows the total number of counts

After you type "mapcount" in the Command Center you will have 5 seconds to move the trundle wheel. After 5 seconds the computer will show how many counts were made.

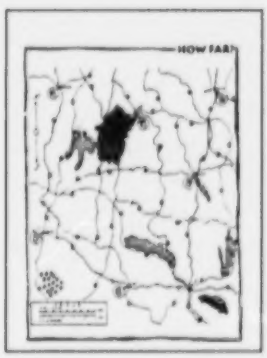
TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 6 ACTIVITIES

FOLLOW THESE STEPS:

STEP 5: Use this procedure to measure how many counts it takes to move the trundle wheel across this book.

STEP 6: The trundle wheel can also be used to measure distances on a map. Using the map, measure the number of counts between Joy and Derby.



Because the counter measures 2 counts per centimeter and the map shows 6 km per centimeter, we know that there are 3 km per count. By changing "show counter" statement to multiply the reading by 3 we can show the number of km between the cities.

STEP 7: Change "show counter" to:

show counter * 3

STEP 8: Using the map, measure the number of kilometers between Joy and Derby.

Using the trundle wheel would be easier if you knew when it stopped counting. We can add a sound so the computer can tell you when it is through.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 6 ACTIVITIES

FOLLOW THESE STEPS:

STEP 9: Just before the "show counter" line, add the line:

```
tone 100 20
```

We can rewrite this program to make it easier to use. Instead of having to redo the program to change the information that the computer shows, we can make the computer change automatically.

STEP 10: Type:

```
np "mapper1
```

STEP 11: Press ESC to return to the menu. With the cursor on "New Page", press return.

STEP 12: Type all of the procedures in the right column. Read the information in the left column to find out what the new commands do.

```
to interactmap
ht                                  Flips to other side and hides the turtle.
cc                                  Clears the Command Center
type [How many km per cm]           Prints the statement on the screen
make "scale readlistcc              Gives the variable "scale" your input
listento 6
resetc
type [measure now]
measure
end
```

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 6 ACTIVITIES

FOLLOW THESE STEPS:

Sets variable "oldm" to the counter's value

Sets "newm" to the counter's value
If "oldm" and "newm" are the same, does the procedures in the brackets
"again" does the "again" procedure

Types the words in brackets and the value of the variables on the screen

Allows user to choose to do the procedure again—gives "key" value which was typed
If "key" is "y" does what is in first brackets;
if "key" is something else, it does the second brackets

```
to measure
make "oldm counter
wait 20
make "newm counter
if :oldm = :newm [cc
   km.moved again]
measure
end

to km.moved
(print [counter =] counter)
(print [Kilometers traveled
   =] ((first :scale) / 2) *
   counter)
end

to again
type [Type y to go again]
make "key readchar
ifelse :key = y [cc listento
6 resetc type [Measure
now] measure][cc stopall]
end
```

STEP 13: Before you try this procedure, move to the Command Center and name and save your page:

```
np "mapper2
```

STEP 14: Now press the key labeled Escape or ESC.

ESC

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 6 ACTIVITIES

FOLLOW THESE STEPS:

STEP 15:	Move the cursor to the name of your page and press ENTER to return to the Procedure Center and Command Center.	ENTER
STEP 16:	To try the procedure, type (in the Command Center):	interactmap
STEP 17:	Using your map, or other available maps, practice using your trundle wheel. Try changing some of the commands to make the program work better for you.	
STEP 18:	When you are finished, set the printer up (get your instructor's help if needed). Move into the Command Center and type:	printtext
STEP 19:	Return all of the LEGO pieces to your instructor and make sure everything in your area has been put away. Turn off your computer.	

If you complete Day 6 Activities with time left over, you may begin Day 7 Activities.

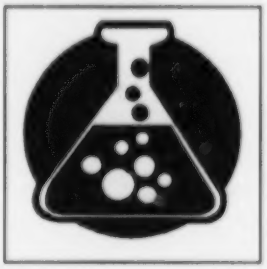
TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 7 ACTIVITIES

On Day 7 you should complete the following activities:

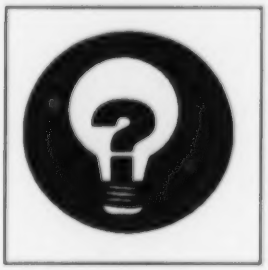
1. Complete Objective 6

SUMMARY OF ACTIVITIES



General Science Skills:
- ◆Apply Computing Skills
- ◆Apply Technology

Physical Science Skills:
- ◆Apply Physical Laws
- ◆Investigate Forms of Energy



Problem Solving Skills:
- ◆Apply New Technology
- ◆Evaluate Results
- ◆Devise a Solution
- ◆Apply Intuitive Thinking Techniques

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 7 ACTIVITIES

OBJECTIVE 6

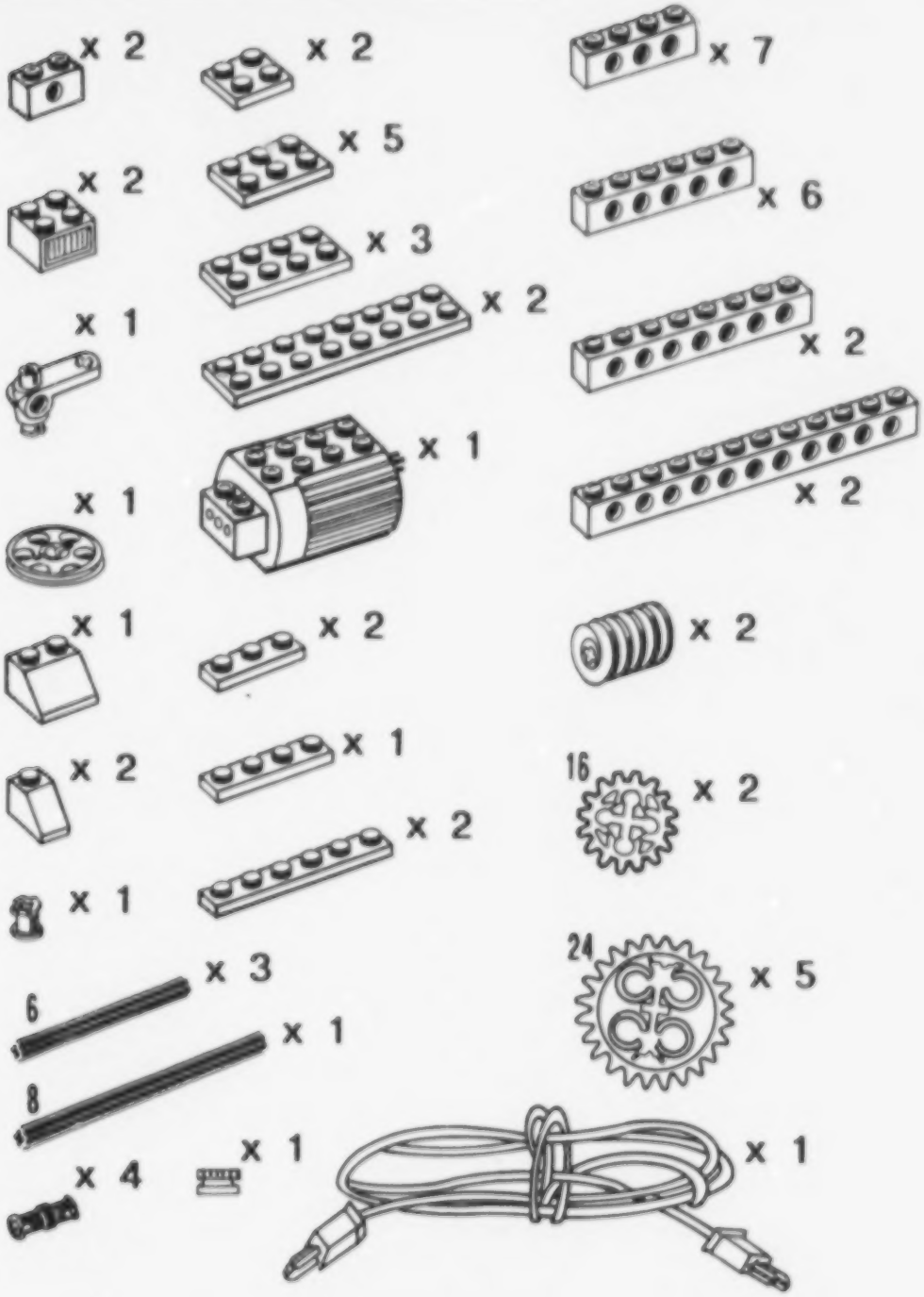
Build a "Dogbot" and program it, including moving the Dogbot and playing music.

TOOLS AND MATERIALS

- LEGO DACTA® Technic Control I Set
- Computer with LEGO Interface Box
- LEGO TC Logo
- The LEGO building elements shown on the next page (get them from your instructor):

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 7
ACTIVITIES



TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 7 ACTIVITIES

INTRODUCTION

Control Technology Systems include many kinds of movement—not just rotary movement. Often rotary movement is changed into reciprocating (back and forth) movement, or reciprocating into rotary. For example, car engines have reciprocating movement inside (where the pistons move in the cylinders) which becomes rotary movement outside (the wheels turn).

Sounds are also important to Control Technology Systems. Cars beep when seatbelts are not fastened, the checkout machines in some supermarkets talk, and microwaves ding when the food is ready. These sounds are controlled by subprocedures of Control Technology Systems.

PROCEDURE

FOLLOW THESE STEPS:

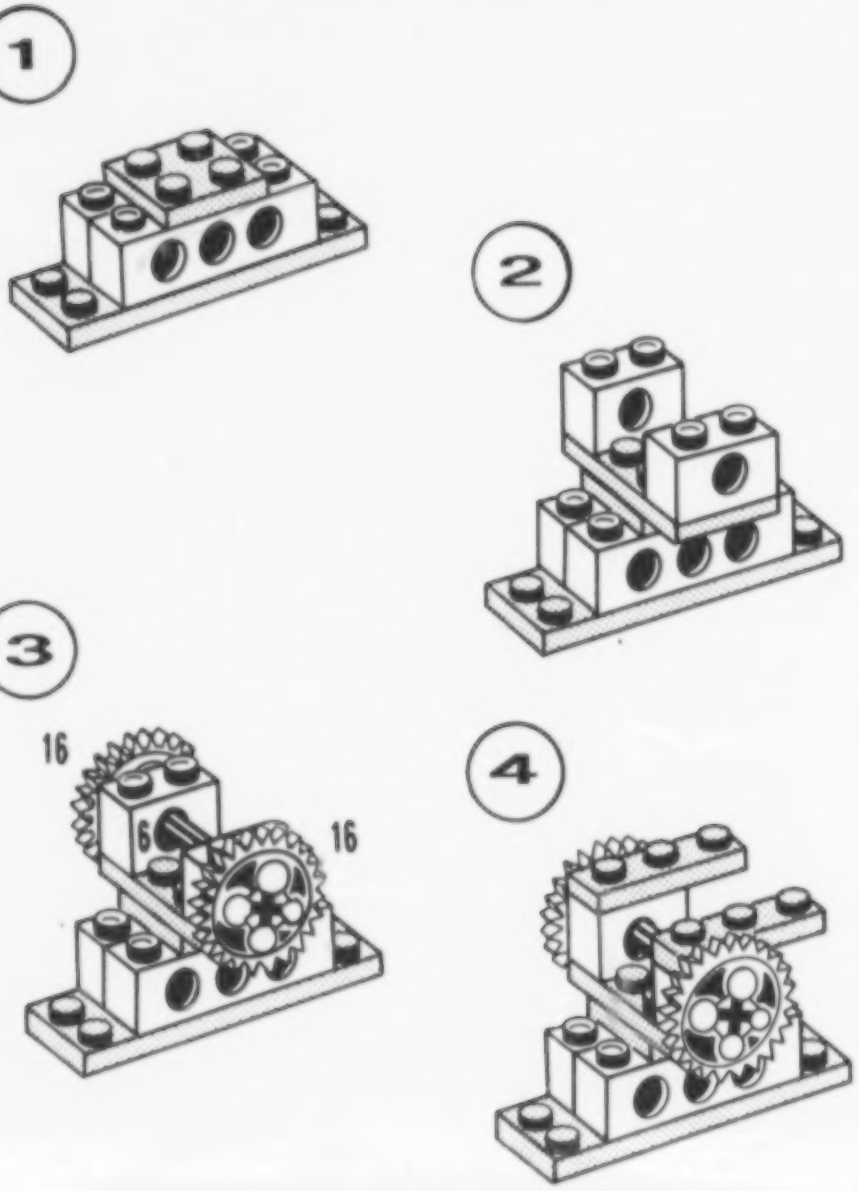
STEP 1: Follow your teacher's instructions to start LEGO TC Logo on your computer.

STEP 2: Plug in the Interface Box and make sure the red Stop button is up. The red light over the Stop Button should be lit.

STEP 3: Build the Dogbot as shown on the following pages.

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

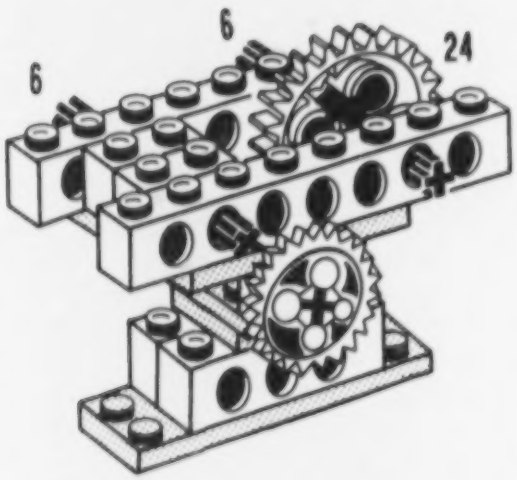
DAY 7
ACTIVITIES



TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 7
ACTIVITIES

5



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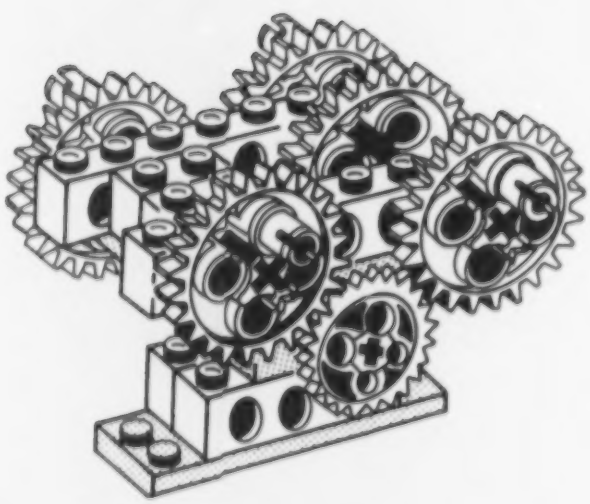
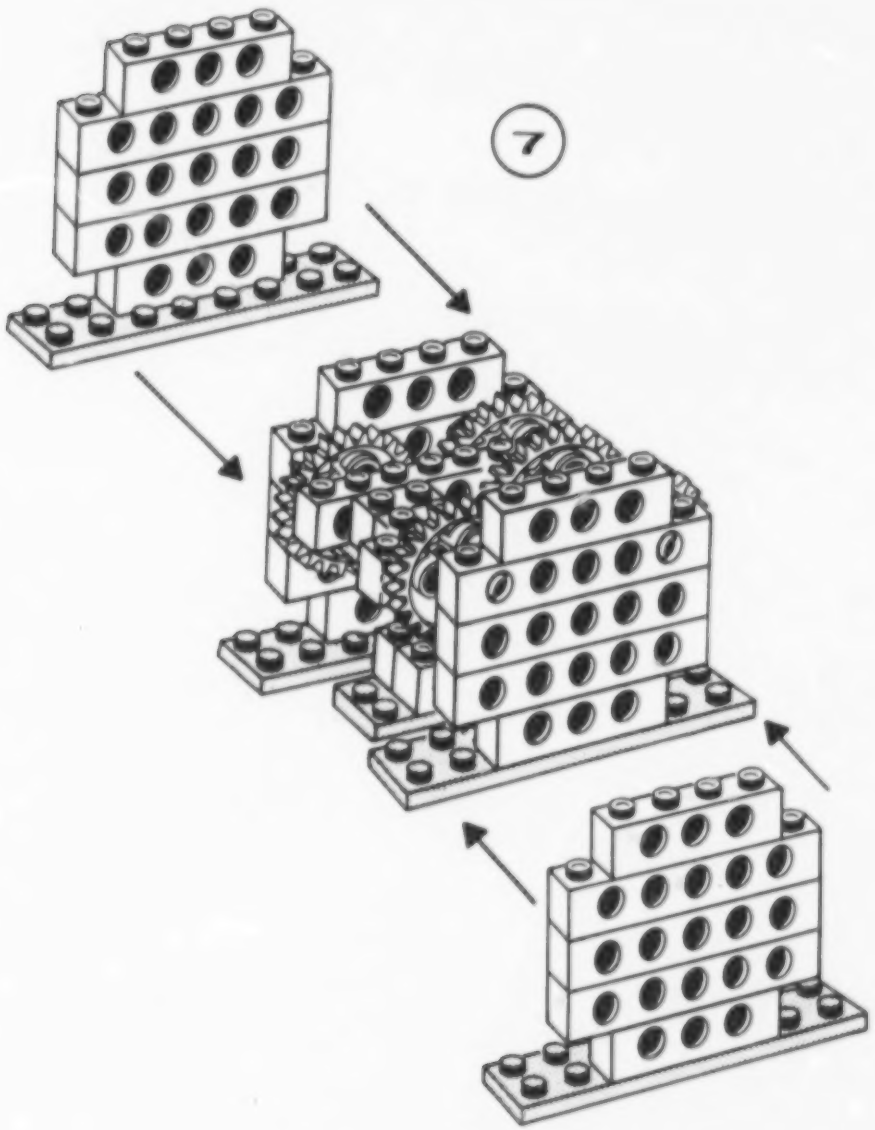


TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

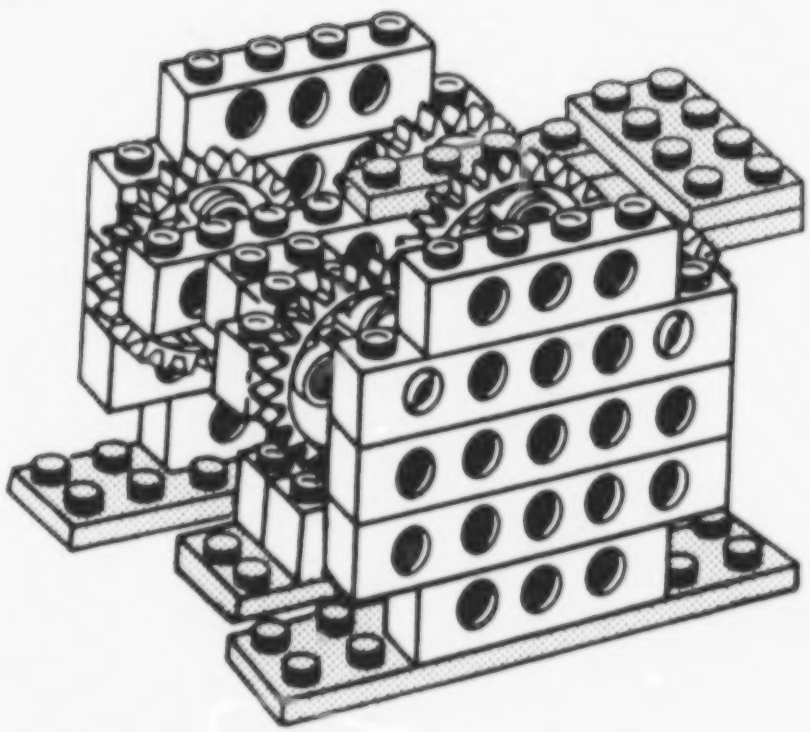
DAY 7
ACTIVITIES



TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

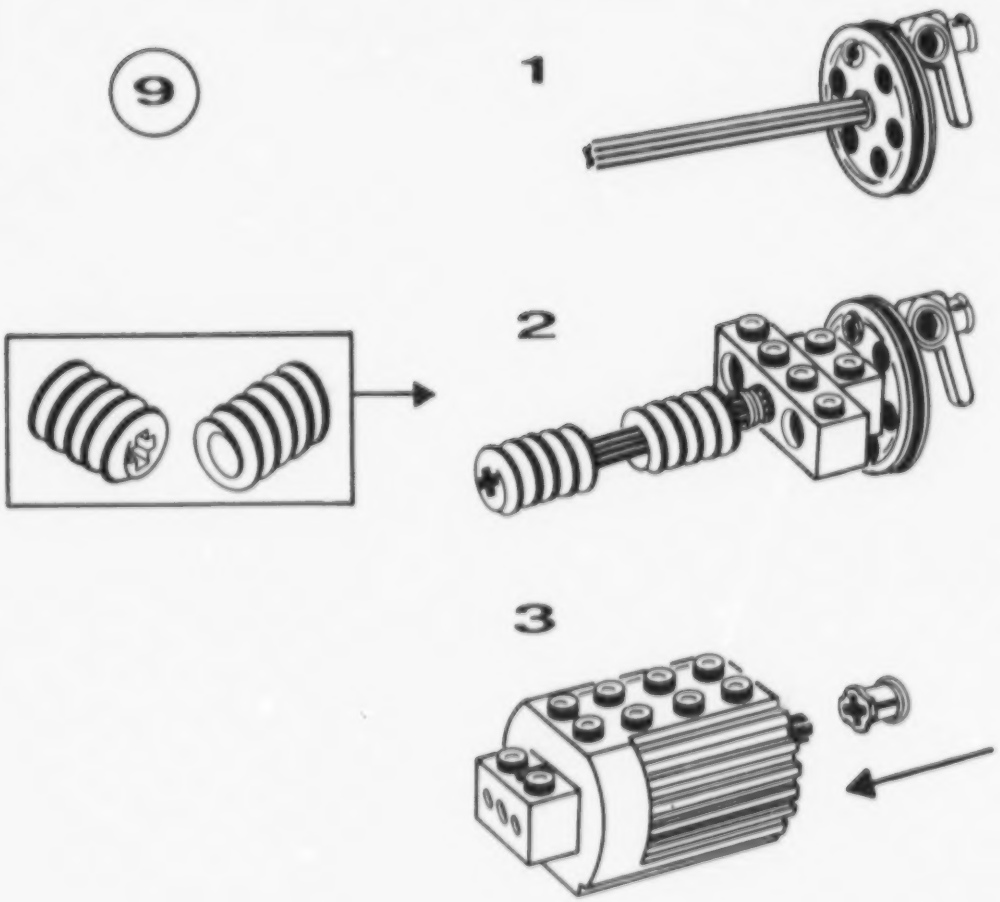
DAY 7
ACTIVITIES

8



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

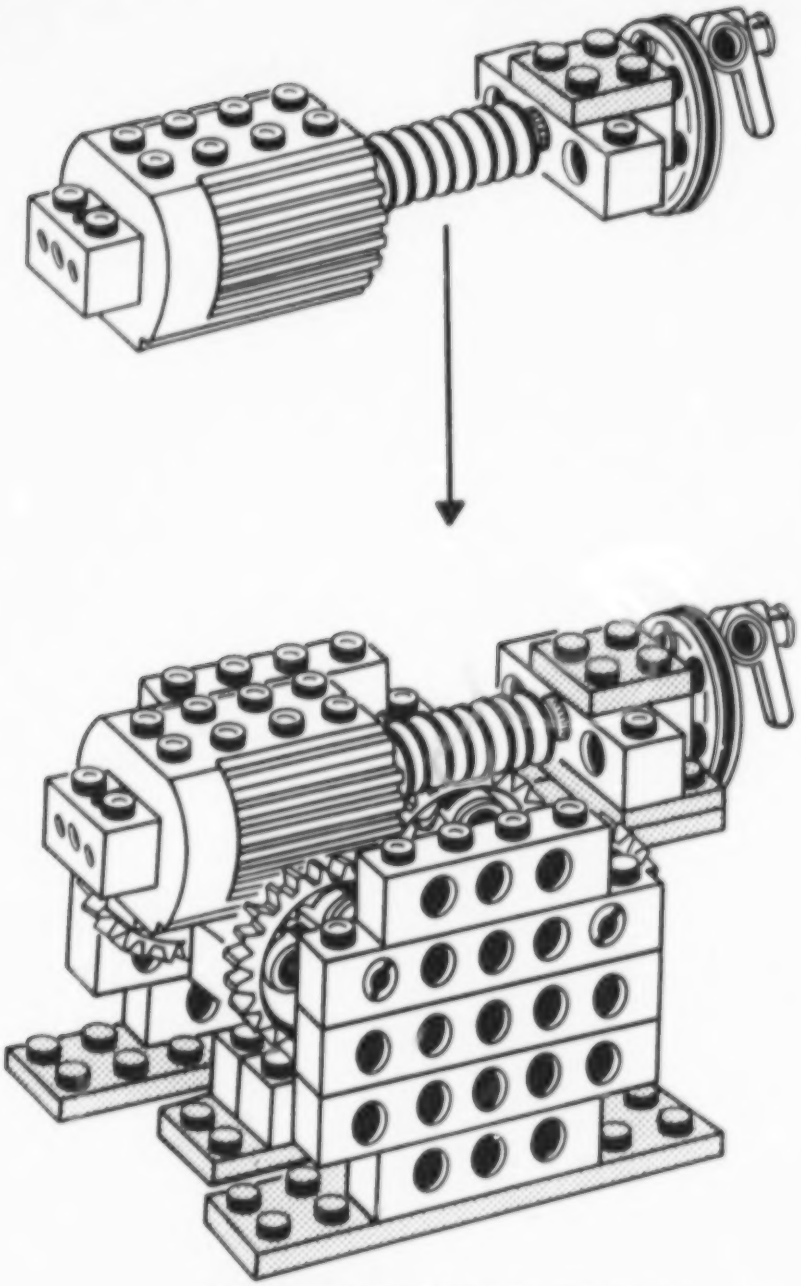
DAY 7 ACTIVITIES



TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 7
ACTIVITIES

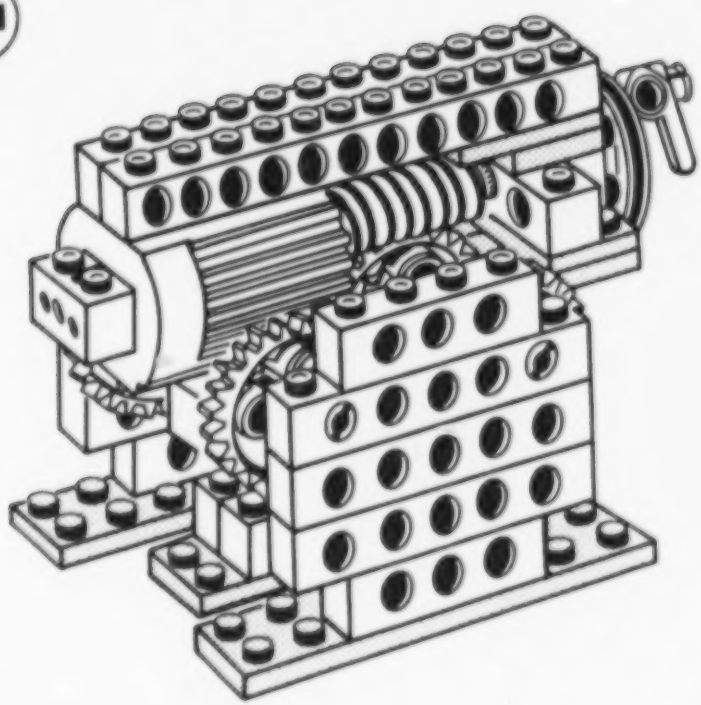
10



TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 7 ACTIVITIES

11

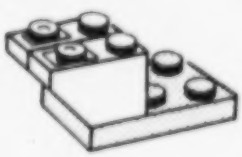


TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 7
ACTIVITIES

12

1



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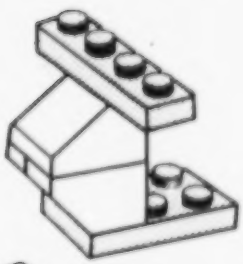

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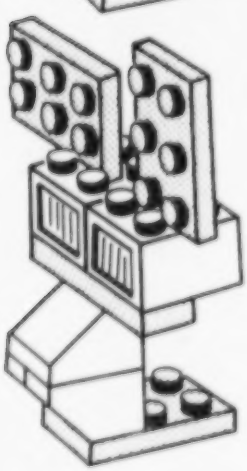
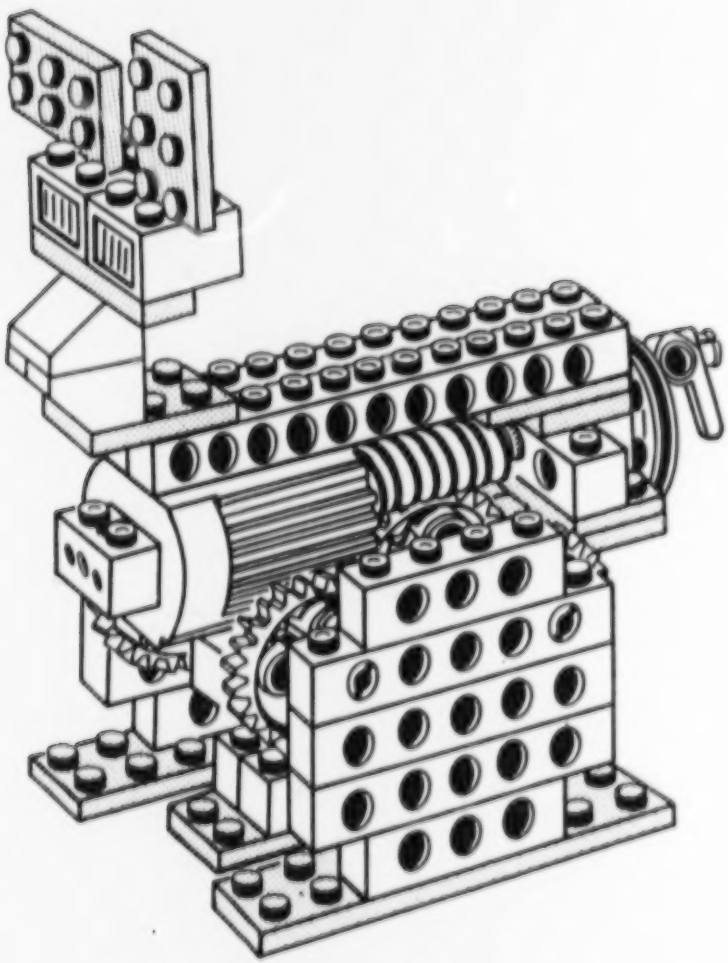


TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 7 ACTIVITIES

13

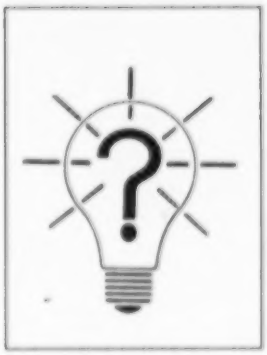


TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

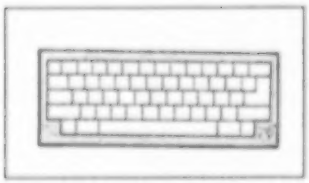
DAY 7 ACTIVITIES

FOLLOW THESE STEPS:

STEP 4: Program the Dogbot to move forward about 11 inches (the height of this page) and to back up the same distance. Experiment with the speed to make the Dogbot move as well as possible. You should use two subprocedures to move the Dogbot—one for forward and one for backward movement.



STEP 5: Test your procedures.



STEP 6: Name and save your page. Call the page "Doggie". np "doggie

STEP 7: Now press the key labeled Escape or ESC. ESC

STEP 8: Move the cursor to New Page and press ENTER to return to the Procedure Center and Command Center. ENTER

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 7 ACTIVITIES

FOLLOW THESE STEPS:

STEP 9: You will write a procedure to play the song "How Much is that Doggie in the Window?" Type the procedure in the right column (the notes are in the left column).

	to music
G	tone 392 6
B	tone 494 4
A	tone 440 4
G	tone 392 4
F	tone 349 6
B	tone 494 3
A	tone 440 3
G	tone 392 8
	end

STEP 10: Test the procedure.

STEP 11: Name and save the music procedure on a page called "tune". Name and save the page.

np "tune

STEP 12: Press ESC to exit to the Menu, then move the cursor down to "doggie" and press ENTER.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 7 ACTIVITIES

FOLLOW THESE STEPS:

STEP 13:	To add the procedure music on the "tune" page to the "doggie" main procedure, move your cursor to just after the movement backward. Type:	**music**
STEP 14:	In the Command Center, type:	**load "tune**
STEP 15:	Now try the whole procedure.	
STEP 16:	Set the printer up (get your instructor's help if needed). Move into the Command Center and type:	**printtext**

Using the load primitive, it is possible to add extra procedures from other programs to your current program. This can save typing time, as well as allowing you to use procedures which you have already debugged.

There is also a getpage primitive, which saves the old page and brings in the new page. Then you can use any of the procedures on the new page. Experiment with the dogbot and the load and getpage commands. Perhaps the Dogbot should have lights, or respond to the warning lights from Day 1 and 3.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 7 ACTIVITIES

FOLLOW THESE STEPS:

STEP 17: When you are finished, return all of the LEGO pieces to your instructor and make sure everything in your area has been put away. Turn off your computer.

If you complete Day 7 Activities with time left over, you may begin Day 8 Activities.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 8 ACTIVITIES

On Day 8 you should complete the following activities:

1. Read Impact Statements.
2. Complete Career Search Activity.
3. Complete any unfinished assignments.
4. Complete Posttest

SUMMARY OF ACTIVITIES

Reading Comprehension Skills:
- Gain factual information
- Make generalizations

Functional Reading Skills:
- Follow written instructions
- Interpret graphics and symbols

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 8 ACTIVITIES

ENVIRONMENTAL IMPACT

Control Technology affects our environment in many positive ways. For example, the use of Control Technology in manufacturing processes reduces waste and uses raw materials more efficiently than older styles of manufacturing. Another use of Control Technology is cleaning up our environment—even in places where humans cannot go. For example, nuclear power plants and waste storage areas are partially maintained by Control Technology devices.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 8 ACTIVITIES

SOCIAL/CULTURAL IMPACT

Control Technology is changing our society, because Control Technology Systems now do many boring or dangerous tasks, allowing people to have safer and more interesting jobs. Some people worry that they might lose their jobs to Control Technology Systems, but Control Technology actually creates jobs by increasing manufacturing possibilities, creating system maintenance jobs, and allowing more people to work in service industries.

ECONOMIC IMPACT

The changes caused by Control Technology are very noticeable due to their economic impact. New manufacturing processes developed with Control Technology reduce waste, produce new goods more quickly and accurately than ever before, and allow more flexibility in the goods manufactured. Before Control Technology, changing a machine to make a different part, or to change an existing part, was very time-consuming and expensive. Now, it can be as easy as typing a new command into a computer. A modern factory uses these advances to make specialized products, which wasn't possible before Control Technology and flexible manufacturing systems.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

DAY 8
ACTIVITIES

POLITICAL IMPACT

Control Technology also affects many important political issues. Since Control Technology Systems are still expensive, only the richer nations and companies can afford them. Because Control Technology helps these people work more efficiently, the poorer nations and companies get further behind. This causes political problems, because some people want to give poorer nations money or Control Technology systems to help them out, and others do not want to spend extra money to help without getting something in return.

ERGONOMIC IMPACT

Control Technology also has an ergonomic effect—it affects how people use products safely, effectively, and comfortably. Electric eyes to open doors, automatic supermarket check-out systems, traffic lights which sense waiting cars, and automatic shutoff coffee makers are all examples of Control Technology being used to make our lives easier, safer and more pleasant.

TECHNOLOGY EDUCATION
ROBOTICS — CONTROL TECHNOLOGY

DAY 8
ACTIVITIES

CAREER SEARCH ACTIVITY

INSTRUCTIONS

Using *Career Search Abstracts*, find the occupations listed below. Select the two occupations that sound the most appealing to you. On a separate sheet of paper list the two occupations you selected and tell why. Remember to write using complete sentences, proper grammar, and correct spelling. Give the completed sheets to your instructor.

RELATED CAREERS

- Electrical and Electronics Engineer
- Electromechanical Equipment Assembler
- Numerical Control Tool Programmer
- Robotics Technician

ROBOTICS — CONTROL TECHNOLOGY: CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES

ELECTRICAL AND ELECTRONICS ENGINEER

Nature of the Occupation

Electrical and electronics engineers conduct research and development activities in relation to the design, manufacture, testing, and application of electrical and electronic components, products, and systems.

Duties may include but are not limited to the following:

- Designing test apparatus
- Devising evaluation procedures
- Developing new and improved devices
- Recommending equipment design changes
- Writing equipment specifications
- Directing field operations
- Maintaining equipment
- Supervising workers and projects

Occupation Specialties

(Dot codes in parenthesis)

Electrical (003.061-026) and **Electronics-Research Engineers** (003.061-038) conduct research in various areas of electrical and electronic applications.

Illuminating Engineers (003.061-046) design and direct installation of illuminating equipment and systems for buildings, plants, streets, and other facilities.

Power System Electrical Engineers (003.167-018) design power system facilities and equipment and coordinate the construction, operation and, maintenance of electric power generating, receiving, and distribution stations, systems, and equipment.

Working Conditions

Electrical and electronics engineers usually work with other engineers, technicians, and construction or manufacturing workers. They may work as part of a specialist team or supervise construction or factory workers.

Electrical and electronics engineers usually work in well-lighted and ventilated offices or laboratories. Others work in factories, power installations, or out-of-doors. Electrical and electronics engineers may be required to relocate to work on different projects. Long-term projects may last two or three years.

Electrical and electronics engineers usually work 40 to 50 hours a week.

Electrical and electronics engineers may join professional organizations such as the National Society of Professional Engineers or the Institute of Electrical and Electronics Engineers. Members pay annual dues.

Worker Requirements

You should like:

- Activities that are scientific and technical in nature
- Activities dealing with things and objects
- Activities relating to processes, machines, and methods

You should be able to:

- Understand and use high level mathematics
- Recognize differences in the size, shape and form of objects, lines, and figures
- Work carefully and pay close attention to details
- Think logically
- Analyze and solve problems based on accurate information
- Make decisions
- Direct, control, and plan activities
- Communicate effectively with others

Physically you must:

- Be able to work with your hands and fingers

OCCUPATION SPECIALTIES

DOT CODE:

003.061-010 Electrical Engineer
003.061-030 Electronics Engineer
003.061-026 Electrical Research Engineer
003.061-050 Planning Engineer, Central Office Facilities
003.061-046 Illuminating Engineer
003.167-018 Electrical Engineer, Power System
003.061-038 Electronics Research Engineer

SOC CODE 1633

OKLAHOMA CAREER SEARCH

ROBOTICS — CONTROL TECHNOLOGY: CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES

ELECTRICAL AND ELECTRONICS ENGINEER

- See well, either naturally or with correction, including color vision
- Talk and hear

Special Requirements:

A Ph.D. degree is required for teaching in a college or university and is usually required for research positions in industry. Electrical and electronics engineers who have primary responsibilities for a project generally are required to be licensed.

Opportunities for Experience:

Scientific and technical hobbies may provide helpful experience in this area. Summer employment in electronics businesses and co-op programs in college offer excellent opportunities for experience. Opportunities are also available through branches of the military service.

Methods of Entry:

Methods of entering this occupation include direct application to employers and civil service exams. Positions may also be located by consulting newspaper want ads, professional publications, college placement offices, and the state employment office.

Earnings and Advancement

Earnings depend upon the type, size, and location of the employing organization and the employee's education, experience, capabilities, and responsibilities.

Earnings:

In 1990, beginning electrical engineers with a bachelor's degree earned an average salary of $32,317. Those with a master's degree had beginning salaries averaging $37,605, and those with a Ph.D. earned salaries averaging $50,645 in 1990.

Electronics engineers working for the Federal Government earned on the average $45,971 in 1990.

Fringe Benefits:

Depending on the employer, electrical and electronics engineers may receive paid vacations and holidays; paid sick leave; life, health, accident and disability insurance; and retirement plans. These benefits are usually paid for, at least in part, by the employer. Some employers may also provide educational reimbursements.

Career Ladder for this Occupation may look like this:

- Chief Engineer - Manager
- Electrical and Electronics Engineer
- Electrical and Electronics Engineer Trainee

Employment and Outlook

There were approximately 439,000 electrical and electronics engineers employed nationally in 1988. Employment is expected to increase much faster than the average through the year 2000 due to the growing demand for computers, communications equipment, military electronics, and electrical and electronic consumer goods.

Electrical and electronics engineers held about 2,475 jobs in Oklahoma during 1986. That number is expected to increase to 2,930 by 1992, which represents a 18.38 percent change. Job openings each year for electrical and electronics engineers will equal approximately 140, with 64 of those due to replacements and 76 created through new jobs.

Related Education and Training

Level(s) of education and training usually needed for this occupation:

- College bachelor's degree
- College master's degree

Level(s) of education and training also available for this occupation:

- Ph.D. degree

School subjects helpful in preparing for this occupation include:

- College Preparatory
- English
- Calculus
- Trigonometry
- Physics
- Cooperative Education-Trade & Industrial
- Electricity & Electronics
- Composition
- Algebra
- Geometry
- Chemistry
- Humanities
- Drafting
- Machine Shop

More Sources of Information

- National Engineering Consortium
  505 N. Lake Shore Drive
  Suite 4808
  Chicago, IL 60611
- Institute of Electrical and Electronics Engineers
  345 East 47th Street
  New York, NY 10017
- JETS Guidance
  1420 King Street, Suite 405
  Alexandria, VA 22314-2715
- Society of Women Engineers
  345 East 47th Street
  Room 305
  New York, NY 10017
- Federal, State, and Local Civil Service Offices
- State Employment Offices

ROBOTICS — CONTROL TECHNOLOGY: CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES

ELECTROMECHANICAL EQUIPMENT ASSEMBLER

Nature of the Occupation

Electromechanical equipment assemblers build, prepare, and test equipment or devices such as dynamometers, ejection seat mechanisms, magnetic drums, and tape drives that contain electronic sensing devices that monitor, control, or activate mechanical operations.

Duties may include but are not limited to the following:

- Reading blueprints or written instructions
- Positioning parts needed to assemble equipment
- Fastening the parts together using hand tools
- Soldering electrical components in place
- Measuring the dimensions and the clearances of parts to ensure that their measurements meet the blueprint specifications
- Adjusting assemblies so that mechanical processes may be completed according to specifications
- Testing the electrical and mechanical reliability of assemblies using a multimeter, oscilloscope, oscillator, gages, test lights, or other tools
- Drilling, reaming, or tapping holes when needed to complete the assembly of equipment, if a precision bench assembler

Occupation Specialties

(Dot codes in parenthesis)

Final Assemblers (706.381-018) assemble, install, and adjust such electromechanical units as feed drivers, control key assemblies, and printing units, on new and rebuilt punch card office machines.

Precision Bench Assemblers (706.681-010) assemble machine parts to make precision aircraft and missile assemblies such as landing gear struts, brakes, fueling equipment, control linkages, actuators, and gearbox mechanisms.

Electromechanical Technicians (710.281-018) fabricate, test, analyze, and adjust precision electromechanical instruments, such as temperature probes, gyroscope units, telemetering systems, altimeters, and aerodynamic probes.

Electromechanical Assemblers (806.381-010) assemble and test solid fuel powered mechanical and electomechanical devices, such as aircraft ejection seat mechanisms.

Working Conditions

Electromechanical equipment assemblers usually work alone, under general supervision; however, some work in teams. Electromechanical technicians work in manufacturing plants or branch facilities, although many install, repair, and maintain equipment at customer facilities.

Electromechanical equipment assemblers generally work in clean, well-lighted, and ventilated facilities. Technicians who make customer service calls are subject to various conditions at different worksites. However, because of the sensitivity of many electromechanical components, a clean, controlled environment must be maintained for proper equipment function. Since these workers frequently work with tiny parts and tools, they may suffer eyestrain. Some assemblers must stand for long periods of time. Precision bench assemblers usually work while seated at their area.

Although electromechanical equipment assemblers usually work eight hours a day, five days a week, schedules may vary. Large plants may have more than one shift. Overtime may be necessary to meet production or customer deadlines. Those technicians who do field work or maintenance may work irregular hours, evenings, or even weekends while equipment is being installed or repaired. Travel, sometimes on short notice, may also be necessary. Assemblers may be subject to layoffs during economic recessions or reductions of government contracts.

Tools, Equipment and Materials used may include:

- Blueprints & Written Specifications
- Templates
- Hand Tools
- Work Tables
- Drill Presses & Punch Presses
- Micrometers, Verniers, Calipers & Height Gages
- Binocular Microscopes
- Atmosphere Test Chambers
- Multimeters, Oscilloscopes, Oscillators & Vacuum Tube Voltmeters
- Hand Reamers, Taps & Files
- Torque Wrenches
- Soldering Tools
- Test Lights
- Power Bench Tools
- Grinders

You should like:

- Working with your hands to make and assemble things
- Doing work involving machines, processes, or methods
- Activities which bring personal satisfaction from working on or producing things

OCCUPATION SPECIALTIES

DOT CODE

806.381-030 Electromechanical Assembler
706.381-018 Final Assembler
706.681-010 Precision Bench Assembler
710.281-018 Electromechanical Technician

SOC CODE 6812, 8769

OKLAHOMA CAREER SEARCH

ROBOTICS — CONTROL TECHNOLOGY: CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES

ELECTROMECHANICAL EQUIPMENT ASSEMBLER

You should be able to:
- Interpret detailed specifications and instructions and apply independent judgment
- Visualize flat drawings or pictures with three dimensions
- See detail in objects or drawings and recognize slight differences in shapes or shadings
- Work skillfully with your hands, if an electromechanical technician
- Rate information using standards that can be verified
- Work within precise limits or standards of accuracy
- Perform a variety of tasks which may change often, if an electromechanical technician

Physically you must:
- Stoop, kneel, crouch, and crawl
- Reach for objects and handle them skillfully
- See well, either naturally or with correction, to follow diagrams and color codes

Special Requirements:

Employees seek workers who can do routine, uncomplicated, and sometimes repetitive tasks while remaining motivated. Some electromechanical equipment assemblers use heavy press machinery and therefore must be 18 years of age or older. Some employers prefer to hire electromechanical equipment assemblers who have associate degrees with a specialty in electronics or mechanical technology or equivalent military training.

Opportunities for Experience:

Secondary vocational education programs in business and vending machine repair and postsecondary programs in electrical and electronics technology may offer co-op opportunities for practical experience.

Students may find a summer or part-time job in manufacturing facilities employing assemblers. Student membership in the Instrument Society of America (ISA), located at many technical institutions, is helpful. Experience in electronics or electromechanical technology may be obtained through a formal apprenticeship.

Earnings and Advancement

Earnings of electromechanical equipment assemblers vary according to the skill level needed in the assembly process, the type of product assembled, the size and location of the plant, and extent of unionization.

Earnings:

Average earnings for all assemblers working full time in 1990 were about $349 a week or $18,123 annually. Wage rates for precision assemblers working under union contracts ranged from about $11.87 to $18.70 an hour in 1990. Beginners earned wages around the lower rate, and after two years earned up to $15.76 an hour. Certain aircraft and other highly skilled assemblers earned $18.70 an hour or more. Some assemblers are paid incentive or piecework rates, and can earn more by working faster.

Career Ladder for this Occupation may look like this:
- Electromechanical Equipment Supervisor or Sales Representative
- Electromechanical Equipment Assembler
- Trainee or Apprentice

Opportunities for advancement in electromechanical equipment assembly work are good, especially for the assembler with strong skills and extra training in electronics. The likeliest candidate for promotion has well-developed technical skills, seniority, leadership potential, and a sense of responsibility.

Employment and Outlook

Nationally, there were about 99,000 electromechanical equipment assemblers employed in 1987. Employment is expected to remain unchanged through the year 2000 due to increased automation and moving operations to countries with cheaper labor. Most job openings will result as workers transfer to other jobs or leave the labor force.

Electromechanical equipment assemblers held about 281 jobs in Oklahoma during 1986. That number is expected to increase to 319 by 1992, which represents a 14.28 percent change. Job openings each year for electromechanical equipment assemblers will equal approximately 11, with 5 of those due to replacements and 6 created through new jobs.

Related Education and Training

Level(s) of education and training usually needed for this occupation:
- On-the-job training
- High school diploma or G.E.D.
- High school diploma with vocational education

School subjects helpful in preparing for this occupation include:
- Blueprint Reading
- Electricity & Electronics
- Shop Math
- Welding
- Cooperative Education-Trade & Industrial
- Metal Shop
- Shop Mechanics

More Sources of Information

Further information is available from local offices of the state employment services.

ROBOTICS — CONTROL TECHNOLOGY: CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES

NUMERICAL CONTROL TOOL PROGRAMMER

Nature of the Occupation

Numerical control tool programmers plan and write programs, using appropriate computer languages and practical knowledge of machine tool operation, for numerically controlled machine tools. The programs are stored on punch tape or cards, magnetic tape, or discs.

Duties may include but are not limited to the following:

- Select cutting tools
- Analyze part drawings, sketches, and design data to determine size and shape of cuts
- Determine machine speed and feeds
- Determine reference points and direction of cutting paths
- Compute angular and linear dimensions, radii, and curvatures
- Outline sequence of machine part operations
- Prepare geometric layout on graph paper showing cutting paths
- Write instruction sheets and cutter lists to guide set-up and operation of machine
- Write program sheets of machine instructions in symbolic language to encode control tape regulating tool movement
- Compare encoded tapes with original program sheets to assure accuracy
- Revise programs to eliminate errors
- Observe trial operation of machines to prove taped instructions

Occupation Specialties

(Dot codes in parenthesis)

Process Control Programmers (020.187-014) plan and write computer programs for control systems that automate operations for such systems as steel making and rolling mill operations, sanitation plants, combustion systems, chemical and fuel recovery systems, computerized production testing, automatic truck loading, steam boilers, and other commercial and industrial process control systems.

Working Conditions

Tool programmers work at desks in well-lighted and air-conditioned offices of manufacturing plants, separate from the noisy areas where machine tools are in use. They are usually supervised by a senior programmer or coordinator for numerical control and may work alone or with other programmers. Occasionally they may observe or assist numerical control machine tool operators on the shop floor.

The average work week for tool programmers is 35 to 40 hours. Some may work evening or night shifts. Overtime may also be necessary to complete emergency work.

Tools, Equipment and Materials used may include:

- Calculators
- Computers & Terminals
- Computer Printouts
- Design Data & Drawings
- Reference Tables & Manuals
- Code Sheets
- Automatic Drafting & Digitizing Machines (machines which sense lines and curves on graphic input and convert them to numerical tape)

Worker Requirements

You should like:

- Doing work of a technical nature
- Working with blueprints, machines, processes, and methods

You should be able to:

- Concentrate and think logically
- Understand and use algebra, geometry, and trigonometry
- Learn specialized, symbolic programming languages
- Picture objects from drawings and diagrams

OCCUPATION SPECIALTIES
DOT CODE:
007.167-018 Numerical Control Tool Programmer
020.187-014 Process Control Programmer
SOC CODE: 3974

OKLAHOMA CAREER SEARCH

ROBOTICS — CONTROL TECHNOLOGY: CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES

NUMERICAL CONTROL TOOL PROGRAMMER

- Organize data and make judgments and decisions
- Communicate with people at all levels
- Adjust to a variety of activities that change frequently
- Work under pressure
- Plan and direct an entire activity
- Make decisions using standards that can be checked or measured
- Work with precise limits or standards of accuracy

Physically you must:
- See well, naturally or with correction

Special Requirements:
Employers prefer to hire skilled machinists, or tool and die makers, or those with technical school training in tool programming. Those hired with previous experience in the metal trades must take courses in tool programming offered by vocational schools or junior colleges.

Opportunities for Experience:
To observe numerical control tool programmers at work, plant tours, or school field trips to automotive and other manufacturing plants that use numerically controlled tools may be available. Postsecondary programs in numerical control technology and robotics technology may provide opportunities for experience.

Methods of Entry:
The most common method of entry is direct application to employers. Assistance may be obtained from college placement offices, local offices of the state employment office, and by consulting trade publications.

Earnings and Advancement

Earnings paid to numerical control tool programmers vary widely and are determined by job specialty, industry location, and size of employer. Earnings tend to be higher in large cities than in small communities.

Earnings:
In 1990, numerical control tool programmers averaged salaries of $608 per week or $31,616 per year.

Fringe Benefits:
Although fringe benefits vary, they usually include paid vacations and holidays; health, disability, and life insurance; sick leave; and pension plans. In addition, some employers provide tuition refunds for work-related training and school courses. Some employers may offer stock purchase/savings plans for salaried employees.

Employment and Outlook

Numerical control tool programmers held about 7,900 jobs in 1988. Almost all worked in manufacturing firms or machine shops producing such durable goods as aircraft parts, industrial machinery and instruments. Most jobs are in large metropolitan areas.

Employment is expected to increase faster than the average for all occupations through the year 2000. In addition to new positions, many openings are expected to replace programmers who change jobs or retire. However, because this occupation is relatively small, the total number of jobs will not exceed that in such declining occupations as tool and die maker, machinist or metalworking, and plastic working machine tool operator.

Related Education and Training

Level(s) of education and training usually needed for this occupation:
- On-the-job training
- Technical junior or community college

School subjects helpful in preparing for this occupation include:
- General Math
- Algebra
- Geometry
- Trigonometry
- Physics
- Machine Shop
- Shop Mechanics
- Computer Science
- Business Data Processing
- Blueprint Reading
- Metal Shop

Numerical control tool programmers held about 1,141 jobs in Oklahoma during 1986. That number is expected to increase to 1,268 by 1992, which represents a 11.40 percent change. Job openings each year for numerical control tool programmers will equal approximately 25, with 4 of those due to replacements and 21 created through new jobs.

More Sources of Information

- The National Machine Tool Builders
  7901 Westpark Drive
  McLean, VA 22102

- The National Screw Machine Products Association
  6700 West Snowville Road
  West Breckville, OH 44141

- The National Tooling and Machining Association
  9300 Livingston Road
  Ft. Washington, MD 20744

- The Tooling and Manufacturing Association
  1177 South Dee Road
  Park Ridge, IL 60068

ROBOTICS — CONTROL TECHNOLOGY: CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES

ROBOTICS TECHNICIAN

Nature of the Occupation

Robotics technicians install, service, troubleshoot, maintain, and repair robots and robot systems. Robotics technicians employed by robot manufacturers also assist in the application and design of robots and in their manufacture and testing. Studies suggest that one operator is needed for every 6 robots, one maintenance person for every 8 robots, and one engineer for every 15 robots.

Duties may include but are not limited to the following:

- Assist engineers design and apply robot systems.
- Inspect electronic components prior to robot assembly.
- Inspect and test robots for defects after assembly by manufacturers.
- Install robots or robot systems at users' sites.
- Provide start-up assistance to users, including qualifying (fine-tuning) performance and accuracy of robots.
- Program robots for desired series of manipulator-gripper (arm-hand) movements manually, or by electronic instructions to a microprocessor, or by setting up and adjusting the sequence by a hand-held "teach" control.
- Troubleshoot installed robots to determine causes of malfunctions, using knowledge of microprocessors, programmable controllers, electronics, circuit analysis, mechanics, hydraulics and pneumatics.
- Disassemble robots to repair or replace defective circuit boards, sensors, controllers, encoders, servomotors, servovalves, or automatic lubrication systems.

- Reassemble robots.
- Train other technicians and skilled workers to operate, program, repair, and service robots.
- Keep records of test procedures and results.

Occupation Specialties

(Dot codes in parenthesis)

Pneumatic Testers and Mechanics (621.381-022) test, adjust, and repair aircraft pneumatic units, such as valves, pumps, and regulators, according to specifications, using hand tools, power tools, and test equipment.

Maintenance Machine Repairers (626.281-010) repair and maintain, according to blueprints and other specifications, production machinery and equipment, such as lathes, drill presses, and broaching, milling, and screw machines, using hand tools, power tools, and precision measuring instruments.

Hydraulic Press Servicers (621.381-018) repair, service, and adjust hydraulic presses used to extrude wire for swaging into bullet slugs.

Controllers, Repairers, and Testers (825.381-018) adjust, clean, repair, and test electric control equipment of computers and rapid transit cars or streetcars, following wiring diagrams and using specialized equipment and hand tools.

Working Conditions

A successful robotics operation is the result of a well-trained team. The robotics technician may work with application and design engineers, machine builders, and customers (if employed by a robot manufacturer). When in the field, the technician must work with the customer's engineers, technicians, and maintenance personnel in the installation and servicing of robots.

Robots are used in such jobs as spray painting, welding, assembly, die casting, machine loading and unloading, plastic molding, forging, and heat treating.

Tools, Equipment and Materials used may include:

- Hand & Power Tools
- Programmable Controllers
- Oscilloscopes
- Multimeters
- Logic Analyzers
- Lubricants
- Laser Interferometers (to check distance or thickness measurements)
- Force Gages
- Electrical Wiring Diagrams
- Blueprints
- Manufacturers' Technical & Procedure Manuals
- Microcomputers
- Cassette Tape Recorders (for programming)
- Videotape Equipment (for training)
- Three-Axis Coordinate Measurement Machine

Worker Requirements

You should like:

- Activities of a scientific and technical nature.
- Activities which involve the use of machines, processes, or methods.
- Activities dealing with things and objects.

OCCUPATION SPECIALTIES

DOT CODE:
- 626.281-010 Maintenance Machine Repairer
- 626.381-018 Hydraulic Press Servicer
- 621.381-022 Pneumatic Tester & Mechanic
- 825.381-018 Controller Repairer & Tester

SOC CODE: 61

OKLAHOMA CAREER SEARCH

ROBOTICS — CONTROL TECHNOLOGY: CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES

ROBOTICS TECHNICIAN

You should be able to:
- Use reason and logic
- Work within precise limits or standards of accuracy
- Apply mathematics quickly and accurately
- Rate information using standards that can be measured or checked
- Look at flat drawings and visualize how they would look as solid objects with height, width, and depth
- Express yourself well, both orally and in writing
- Work easily and skillfully with your hands
- See detail in objects or drawings and recognize slight differences in shapes or shadings
- Coordinate the use of your eyes and hands to perform tasks

Physically you must:
- See well, either naturally or with correction, and have normal color vision
- Use your arms, hands, and fingers well to reach for, handle, and manipulate objects

Opportunities for Experience:

Summer or part-time work is seldom available for robotics technicians. Building or repairing electronic equipment, radios, or television sets will develop desirable skills. Postsecondary programs in robotics technology may offer co-op opportunities which include practical experience. At the postsecondary school level, individuals may join a student chapter of Robotics International (RI/SME) to learn more about robotics through technical programs, plant tours, and on-campus conferences.

Earnings and Advancement

The salaries of robotics technicians depend largely on the technician's education, experience, and job responsibilities. The size and type of employer are also factors that affect salaries.

Earnings:

According to limited data, the salaries of inexperienced robotics technicians ranged from about $17,500 to $27,000 per year in 1990. Some technicians earn as much as $30,000 after several years on the job. Experienced technicians in supervisory or managerial positions earned from $35,000 to $45,000 or more per year in 1990. In the auto industry, skilled trade workers such as electricians, industrial machine repairers, tool makers, and millwrights maintain robots. These workers earned salaries in 1990 ranging from $27,028 to $36,408 per year, to which cost-of-living allowances (COLA) were added. Technicians are also reimbursed for job-related travel expenses.

Employment and Outlook

Nationally, there are over 60 U.S. based companies that are selling or intend to sell robots. About 6,000 robots were estimated to be in use in the United States in early 1987. About 35 percent are in the auto industry. According to some experts, there will be from 100,000 to 300,000 robots in use by 1990, with 30,000 expected to be used in the automotive industry alone.

The trend towards "flexible automation" in manufacturing in the 1980s will have a positive impact on the demand for industrial robots and technicians. "Flexible automation" is designed so that a job function can be changed quickly to a different, but similar, function.

According to one study, robotics has the potential to create 70,000 to 100,000 new jobs by 2000, many of which may be filled by retrained workers. The net result will be that, with worker retraining, robotics has the potential to create more jobs than it destroys.

Related Education and Training

Level(s) of education and training usually needed for this occupation:
- On-the-job training
- Technical junior or community college

Level(s) of education and training also available for this occupation:
- College bachelor's degree

School subjects helpful in preparing for this occupation include:
- Algebra
- General Math
- Computer Science
- Geometry

More Sources of Information

- IEEE Robotics & Automation Council
  c/o Institute of Electrical & Electronics Engineers
  345 East 47th Street
  New York, NY 10017

- Machine Vision Association & Robotics International of SME
  P.O. Box 930
  One SME Drive
  Dearborn, MI 48121

TECHNOLOGY EDUCATION
ROBOTICS —
CONTROL TECHNOLOGY

DAY 8
ACTIVITIES

POSTTEST

INSTRUCTIONS

You will need a computer scan sheet or card to record your answers to the following Posttest. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet using a #2 pencil. Use rows 11-20 to record the answers to the Posttest. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 11-20.

SPELLING TEST INSTRUCTIONS

Use rows 21-30 on the test card. If the word is spelled correctly, mark (a) on the computer score sheet or card. If the word is spelled incorrectly, mark (b) on the test card. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 21-30.

(a) correct (b) incorrect

Get Posttest Questions from your instructor.

When you finish the Posttest, return the test form and the computer scan card or notebook paper to your instructor.

If you complete Day 8 Activities with time left over, you may complete a Skunk Works Activity.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

SKUNK WORKS

BACKGROUND

The term Skunk Works comes from an engineering division of the 3M Company. In the late 1960s a group of engineers at 3M wanted to design a new product, but the managers of the company would not give them the time or money for research. So they decided to design the product anyway, then try to convince the company to market it. Whenever the engineers could grab a few extra minutes from their regular assignments, they worked on the new product. In early 1969 they presented it to the marketing division of 3M and the company has been selling it ever since. The product: Velcro fasteners.

CHALLENGE

Your *Skunk Works Challenge* is to build a vehicle and program it to move 8½ inches, activate a visual signal (such as a light), move backward 8½ inches, and activate an audible signal (such as a musical note). Before you start, think about what "vehicle" means. Look it up in **Words You Should Know** on Day 1, and carefully read what it says.

After you construct your vehicle and program it, you must write an essay telling why you chose to build your vehicle the way you did. The essay must be at least one page long, with correct spelling, punctuation, and grammar.

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

SKUNK WORKS

TOOLS AND MATERIALS

- LEGO DACTA® Technic Control I Set
- Computer with LEGO Interface Box
- LEGO TC Logo
- Pencil
- Notebook paper
- The LEGO building elements you need (get them from your instructor)

TECHNOLOGY EDUCATION ROBOTICS — CONTROL TECHNOLOGY

SKUNK WORKS

FOLLOW THESE STEPS:

STEP 1: Design and build your vehicle.

STEP 2: Program the vehicle to move 8½ inches, activate a visual signal, move backward 8½ inches, and activate an audible signal.

STEP 3: Save and print your program.

STEP 4: Write the essay telling why you chose to build your vehicle the way you did.

STEP 5: Return the LEGO pieces to your instructor, be sure everything has been put away, and turn off the computer.